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The Death of Rules and Standards

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Scholars have examined the lawmakers' choice between rules and standards for decades. This Article, however, explores the possibility of a new form of law that renders that choice unnecessary. Advances in technology (such as big data and artificial intelligence) will give rise to this new form—the microdirective—which will provide the benefits of both rules and standards without the costs of either.

Lawmakers will be able to use predictive and communication technologies to enact complex legislative goals that are translated by machines into a vast catalog of simple commands for all possible scenarios. When an individual citizen faces a legal choice, the machine will select from the catalog and communicate to that individual the precise context-specific command (the microdirective) necessary for compliance. In this way, law will be able to adapt to a wide array of situations and direct precise citizen behavior without further legislative or judicial action. A microdirective, like a rule, provides a clear instruction to a citizen on how to comply with the law. But, like a standard, a microdirective is tailored to and adapts to each and every context.

While predictive technologies such as big data have already introduced a trend toward personalized default rules, in this Article we suggest that this is only a small part of a larger trend toward context-specific laws that can adapt to any situation. As that trend continues, the fundamental cost trade-off between rules and standards will disappear, changing the way society structures and thinks about law.

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INTRODUCTION

Imagine a world where lawmakers enact a catalog of precisely tailored laws, specifying the exact behavior that is permitted in every situation. The lawmakers have enough information to anticipate virtually all contingencies, such that laws are perfectly calibrated to their purpose—they are neither over- nor underinclusive. Now imagine that when a citizen in this world faces a legal decision, she is clearly informed of exactly how to comply with every relevant law before she acts. This citizen does not have to weigh the reasonableness of her actions, nor does she have to search for the content of a law. She just obeys a simple directive. The laws at work in this world are not traditional rules and standards. Instead, they take a new form that captures the benefits of both rules and standards without incurring the costs. This new form—we call it the microdirective—is the future of law.

When lawmakers enact laws today, they must choose between using rules and using standards to achieve a desired goal.[1] This choice requires a trade-off between certainty and calibration. Rules provide certainty through clear ex ante statements of the content of the law.[2] But rules are costly to design because lawmakers must, at the

1. The trade-off occurs on a particular level. Any given law may use rules for some components and standards for others. Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557, 561 n.6 (1992); *see* John O. McGinnis & Steven Wasick, *Law's Algorithm*, 66 FLA. L. REV. 991, 1027 (2014) ("[I]n the real world, rules and standards rarely exist as perfect Platonic forms."). For demonstrative purposes, we follow convention in discussing the rules-standards decision as a binary choice.

2. The literature on this distinction is vast. *See* WARD FARNSWORTH, THE LEGAL ANALYST: A TOOLKIT FOR THINKING ABOUT THE LAW 163–71 (2007); JOSEPH RAZ, PRACTICAL REASON AND NORMS (1990); Cass R. Sunstein, *Problems with Rules*, 83 CAL. L. REV. 953,

outset, identify and analyze all the various scenarios to which rules might apply. Rules can also be imprecise and error prone. Because they are defined ahead of time, they can be poorly calibrated[3] to the events as they actually occur.[4]

Standards, on the other hand, are adjudicated after the fact. As a result, lawmakers avoid high up-front design costs. Moreover, when applied after the fact, standards can be precisely tailored or calibrated to a specific context as it actually arose.[5] But they also generate ex ante uncertainty because regulated actors do not know up front whether their behavior will be deemed by the adjudicator to comply with the standard.[6]

We suggest that technological advances in predictive and communication technologies will render this trade-off between rules and standards unnecessary. A new form of law, the microdirective, will emerge to provide all of the benefits of both rules and standards without the costs of either. These microdirectives will provide ex ante behavioral prescriptions finely tailored to every possible scenario.

The first technology to consider is *predictive technology*. Innovations in big data and artificial intelligence will make it increasingly easy to predict the outcomes that certain behavior will produce. Lawmakers will ultimately have the ability to cheaply gather information and use predictive algorithms and big data to update the law

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961–62 (1995); *see also* Isaac Ehrlich & Richard A. Posner, *An Economic Analysis of Legal Rulemaking,* 3 J. LEGAL STUD. 257 (1974); Kathleen M. Sullivan, *The Supreme Court, 1991 Term—Foreward: The Justices of Rules and Standards*, 106 HARV. L. REV. 22 (1992). *See generally* Kaplow, *supra* note 1 (explaining the distinction from an economic perspective); Frederick Schauer, *The Tyranny of Choice and the Rulification of Standards,* 14 J. CONTEMP. LEGAL ISSUES 803, 803 n.1 (2005) (same).

3. We use the term calibration to denote the fit of a law to its legislative purpose. For example, a fifty-five miles-per-hour speed limit may be poorly calibrated because it is too low when the weather is perfect and the roads are clear and too high when the weather is bad and the roads are crowded. Another term could be "inclusiveness." The fifty-five miles-per-hour speed limit is both under- and overinclusive because it prohibits some desirable behavior (driving sixty miles per hour on a sunny day) and allows some undesirable behavior (driving fifty miles per hour on a rainy day). *See* Colin S. Diver, *The Optimal Precision of Administrative Rules*, 93 YALE L. J. 65, 73–74 (1983) (exploring the costs of rulemaking and defining under- and overinclusiveness); Kaplow, *supra* note 1, at 565; McGinnis & Wasick, *supra* note 1 at 1030–31; Frederick Schauer, *The Convergence of Rules and Standards*, 2003 N.Z. L. REV. 303, 305–09; Schauer, *supra* note 2, at 803–04; Sunstein, *supra* note 2, at 992. What we call calibration is similar to what Diver calls congruence. Diver, *supra*, at 67.

4. More formally, in law-and-economics terms, a rule introduces high ex ante decision and error costs because it is costly to predict and set rules for every possible scenario. *See infra* Part I.A.

5. This precision is less costly for standards because the adjudicator only has to figure out the context-specific applications for cases that actually arise, whereas an ex ante rule has to address all possible applications. *See* Kaplow, *supra* note 1, at 562–63; McGinnis & Wasick, *supra* note 1, at 1031; Sunstein, *supra* note 2, at 1003–04.

6. Kaplow, *supra* note 1, at 569, 575 n.42, 587–88; Sunstein, *supra* note 2, at 974–77; *see also* Richard Craswell & John E. Calfee, *Deterrence and Uncertain Legal Standards*, 2 J.L. ECON. & ORG. 279 (1986) (modeling the costs of uncertain standards); Duncan Kennedy, *Form and Substance in Private Law Adjudication*, 89 HARV. L. REV. 1689–701 (1976). Our comparisons here assume unbiased lawmakers and judges. We discuss bias in Part II.

instantly based on all relevant factors.[7] In effect, this lowers the cost of designing precise, finely calibrated laws.

The second technology to consider is *communication technology*. Ubiquitous and instantaneous communication capabilities will reduce the uncertainty of law. From the vast catalog of rules generated by predictive technology, communication technology will be able to identify the rules applicable to an actual situation and inform the regulated actor exactly how to comply with the law.[8] It will be able to translate all the information into a single behavioral directive that individuals can easily follow.

To see how the mechanism might work, consider the regulation of traffic speed. In a world of rules and standards, a legislature hoping to optimize safety and travel time could enact a rule (a sixty miles-per-hour speed limit) or a standard ("drive reasonably"). With microdirectives, however, the law looks quite different. The legislature merely states its goal. Machines then design the law as a vast catalog of context-specific rules to optimize that goal. From this catalog, a specific microdirective is selected and communicated to a particular driver (perhaps on a dashboard display) as a precise speed for the specific conditions she faces. For example, a microdirective might provide a speed limit of 51.2 miles per hour for a particular driver with twelve years of experience on a rainy Tuesday at 3:27 p.m. The legislation remains constant, but the microdirective updates as quickly as conditions change.

In this Article, we explore whether this example could become the model for law more broadly. Our long-run prediction is that microdirectives will become the dominant form of law, culminating in the death of rules and standards. But even if that full evolution does not happen, microdirectives are certain to become a viable alternative for many laws. This short-run phenomenon is of great importance, as even a limited spread of microdirectives has the potential to change the way laws are structured and thought about generally.

This advent of microdirectives may take various paths. In the simplest story, the legislature uses the new technology and communicates the command to the citizen. We use this example to illustrate the concept. More realistically, however, the technology will often be implemented at the administrative level by regulators and enforcement agencies. Lawmakers may still enact standards, but administrative agents will convert them to microdirectives. A third possibility is that private citizens will generate the microdirectives. Citizens using private predictive technology may

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7. The optimal rate of change in law (from the perspective of social welfare or some other legislative goal) may be slower. But that optimal rate could be factored in by the technology. *See infra* Part III.B. Courts currently update standards over the span of many years. *See* Oliver Wendell Holmes, Jr., Justice of the Supreme Judicial Court of Massachusetts, The Path of the Law, Address at the Dedication of the New Hall of the Boston University School of Law (Jan. 8, 1897), *in* 10 HARV. L. REV. 457 (1897).

8. We define communication function to include two steps. First, there is the communication of the context of an actual scenario to the machine. Second, there is the communication of the legal directive from the machine to the individual. *See infra* Part I.B. The first step might alternatively be called fact gathering. We lump them together because, in practice, the technology facilitating the information flow in each direction is likely to be the same or closely related.

inform themselves of the most reasonable action in any particular situation. As that private technology gets better, two things will happen. First, failure to use the technology will become a per se violation of a legal standard. And, second, the technology will be able to predict judicial outcomes. Both effects will result in citizens using private technology to derive a simple microdirective for how to comply with the law.

For all of these paths, the result is that laws that look like standards to the legislatures will appear as simple and easy-to-follow directives to the regulated individual. This form of law is neither a standard nor a rule. It provides the certainty of a rule and the calibration of a standard, with none of the decision costs associated with either. Moreover, the law, in application, morphs from a standard (for the legislature) to a set of complex rules (within the machine process) to a simple command (for the citizen).

We describe the rise of microdirectives as the death of rules and standards. One might alternatively frame the coming change simply as the death of standards. After all, microdirectives are ex ante rules that govern behavior. The driver in our example is told exactly how to behave ex ante. In that framing, technology has reduced the cost of precise ex ante rule making. Rules will no longer be over- and underinclusive. As a result, the rationale for using standards goes away. That is consistent with the conventional law-and-economics definition of a rule as having ex ante content (relative to the regulated actor). But the lawmakers are not enacting rules. The lawmakers need not spend the time to prescribe precise rules. They can enact broad standards and let the machines do the rest. Indeed, from the perspective of the lawmakers, it is the death of rules. The framing is less important than the recognition that microdirectives will change the foundational nature of law.[9]

Our analysis is positive rather than normative. One might think of perfect calibration of laws to legislative goals as problematic in a system with multiple branches and checks and balances. Indeed, our analysis implies a reduced role for judges and perhaps the need for institutional reforms to preserve important aspects of our current system. Others may view microdirectives as a threat to privacy and autonomy. The easier it is for the government to learn information about the behavior of an individual and use technology to predict outcomes, the more the government can micromanage to achieve desired social results. Finally, some may have concerns about ethics and moral health in a world where many important decisions are automated.[10] We do not take a side on these normative questions. We do, however, try to flag the areas where the thorniest normative questions will arise.

The primary contribution of this Article is to explore the most far-reaching effects

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9. This question of framing suggests an interesting semantic deficit in the way legal academics talk about rules and standards. Readers of our earlier drafts have been equally split on what it means to call something a rule. Some infer that the label "rule" denotes an ex ante statement of content from the lawmaker. Others infer that it denotes an ex ante instruction for the regulated individual. That disconnect does not matter much with traditional lawmaking. But as microdirectives proliferate, the tension will come to the forefront. As a result, not only do actual rules and standards die, but so too does the meaningful use of those words to label the laws that exist.

10. *See, e.g.*, Seana Valentine Shiffrin, *Inducing Moral Deliberation: On the Occasional Virtues of Fog*, 123 HARV. L. REV. 1214, 1222, 1244 (2010) (standards provide for ethical decision making important to moral health).

of technology on the general structure of law. This contribution builds on and connects with two strands in the law-and-technology literature. The first strand looks at the effects that predictive technology has on the legal services industry.[11] The second strand looks at the nature of personalized default rules.[12]

We suggest, however, that these strands understate the momentous effect that the coming technological revolution will have on law.[13] By connecting the growing literature on technology and the law to the literature on rules and standards, we show that the same technology that will bring us automated compliance lawyers and personalized default rules will also bring us the microdirective.[14] And that change in the form of law will have broader consequences than retail personalization of law. Indeed, microdirectives have the potential to bring wholesale institutional changes to our entire system of laws and the way we choose to regulate behavior.

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11. Some scholars predict the effects of technology on legal services. RICHARD SUSSKIND, THE END OF LAWYERS? RETHINKING THE NATURE OF LEGAL SERVICES (2010); RICHARD SUSSKIND, TOMORROW'S LAWYERS: AN INTRODUCTION TO YOUR FUTURE (2013) [hereinafter SUSSKIND, TOMORROW'S LAWYERS]; Daniel Martin Katz, *Quantitative Legal Prediction—or —How I Learned To Stop Worrying and Start Preparing for the Data-Driven Future of the Legal Services Industry*, 62 EMORY L.J. 909, 914–15 (2013). Others explore the current trends in legal markets and provide guidance for how law schools should respond to these trends. William D. Henderson, *A Blueprint for Change*, 40 PEPP. L. REV. 461 (2013); Bruce H. Kobayashi & Larry E. Ribstein, *Law's Information Revolution*, 53 ARIZ. L. REV. 1169 (2011); *see also* William D. Henderson, *From Big Law to Lean Law*, 38 INT'L REV. L. & ECON. 5 (2013) (exploring the changing trends in markets for legal services); Larry E. Ribstein, *The Death of Big Law*, 2010 WISC. L. REV. 749 (predicting the demise of big law firms); Brian Sheppard, *Incomplete Innovation and the Premature Disruption of Legal Services*, 2015 MICH. ST. L. REV. 1797 (predicting the consequences of technological innovation on the legal services industry).

12. *See, e.g.*, Ariel Porat & Lior Jacob Strahilevitz, *Personalizing Default Rules and Disclosure with Big Data*, 112 MICH. L. REV. 1417 (2014). Porat & Strahilevitz provide a theory of personalized default rules in a world of big data. We jump off from that point to explore the wholesale effects of technological advances on law more generally. *See* Omri Ben-Shahar & Ariel Porat, *Personalizing Negligence Law*, 91 N.Y.U. L. REV. 627 (2016); George S. Geis, *An Experiment in the Optimal Precision of Contract Default Rules*, 80 TUL. L. REV. 1109 (2006); Cass R. Sunstein, *Deciding by Default*, 162 U. PA. L. REV. 1 (2013).

13. The closest work to ours is that of John McGinnis and Steven Wasick. McGinnis & Wasick, *supra* note 1. Though they reach strikingly different conclusions, McGinnis and Wasick begin in the same place as we do, asking how technological advances that reduce information costs will affect the balance of rules and standards. Focusing primarily on legal search technology and the ability to predict judicial outcomes, they predict a world where standards and dynamic rules are favored over simple rules. *Id*. at 1049–50. Building on this analysis, we add in the effects of communication technology and machine learning to show that standards and rules (simple and dynamic) will no longer be viable forms of law.

14. Porat & Strahilevitz note that the dichotomy of personal and impersonal rules is not the same as the dichotomy of rules and standards. Porat & Strahilevitz, *supra* note 12, at 1457–58. Personalized defaults can be rules or standards. And impersonal defaults also come in both forms. *Id*. Beyond that observation, Porat and Strahilevitz focus their attention on the personal-impersonal dichotomy. Our analysis suggests, however, that all laws—both personal and impersonal—will ultimately gravitate toward microdirectives that transcend the distinction between rules and standards.

The Article proceeds as follows. Part I sets out our general theory of microdirectives and provides demonstrative examples. Part II explores the feasibility of the technologies behind microdirectives. Part III discusses implications and broader consequences of the rise of microdirectives and the death of rules and standards. A final section concludes.

I. THE EMERGENCE OF MICRODIRECTIVES AND THE DECLINE OF RULES AND STANDARDS

In this Part, we spell out how technology will affect the administration of law and the structure of legal content. We outline two types of technology that will lead to a dramatic reduction in the cost of calibrating and communicating ex ante legal directives, thereby eliminating the need to choose between rules and standards. The analysis is presented in three sections. First, we briefly review the distinction between rules and standards and outline the cost choices presented by the dichotomy. Second, we set out our core theory that technology will fundamentally change those cost choices. We provide two examples to demonstrate how predictive and communication technologies will pave the way for microdirectives that capture the benefits of both rules and standards. Third, we discuss how the emergence of microdirectives can take place through different branches of lawmaking or can be driven by private actors with access to predictive technology.

A. Background: Rules and Standards

Rules are precise and ex ante in nature. Rules indicate to an individual whether certain behavior will violate or comply with the law. When a rule is enacted, effort must be undertaken by lawmakers to give full and precise content to the law before the individuals act. Standards, on the other hand, are imprecise when they are enacted.[15] The exact content of the law comes after an individual acts, as judges and other adjudicators determine whether the individual's specific behavior in a particular context violates the standard.

Generally, lawmakers incur both error costs and decision costs when enacting a law. Error costs arise when a law is over- or underinclusive; the law allows behavior that should be prohibited, or prohibits behavior that should be allowed.[16] Errors can be reduced as lawmakers exert greater effort to get the law right. But this requires information and deliberation. Reducing error costs imposes decision costs on the lawmakers. Additionally, regulated individuals face a cost in figuring out whether their behavior complies with the law. When the application of the law to a particular situation cannot be easily predicted, the individual incurs cost of legal uncertainty.

Error, decision, and uncertainty costs arise in different ways for rules and standards. The classic models in the rules-versus-standards literature conclude that, for

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15. Standards are found wherever vague and ambiguous terms such as "reasonable," "material," or "excessive" are used in the law. *See* Schauer, *supra* note 3, at 308–09; Schauer, *supra* note 2, at 804–05.

16. McGinnis & Wasick, *supra* note 1, at 1031.

several reasons, standards tend to perform better when the behavior of the regulated actors is infrequent and heterogeneous.[17]

First, when behavior of regulated actors is infrequent, standards generate lower decision costs because the content of the law only needs to be decided in the infrequent event that the relevant context actually arises. Rules, on the other hand, require ex ante decisions about all future possible scenarios. Where behavior is infrequent and heterogeneous, lawmakers must make many more decisions if they want to write rules that are as precise in application as a standard that is adjudicated ex post would be. Rules do, however, impose lower decision costs when behavior is frequent and homogeneous. Economies of scale kick in and a law need only be enacted once rather than litigated over and over again.[18]

Second, error costs for standards are lower when behavior is infrequent and heterogeneous because the adjudicator determining the content of the law ex post has more information than the ex ante lawmaker. The adjudicator has additional context not available to the ex ante lawmaker and has the benefit of hindsight in identifying which factors are relevant.

On the other hand, adjudicator competency and bias complicate this simple model of error costs.[19] Ex post adjudication may suffer from hindsight bias[20] and from biases based on the personal characteristics of particular individuals.[21] Such biases can manifest themselves in arbitrariness, political favoritism, covert influence, inconsistency, and discretionary justice[22] even when judges believe they are being

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17. *See, e.g.*, Louis Kaplow & Steven M. Shavell, *Economic Analysis of Law*, *in* 3 HANDBOOK OF PUBLIC ECONOMICS 1665, 1744–45 (Alan J. Auerbach & Martin Feldstein eds., 2002).

18. Strict application of the doctrine of precedent also introduces economies of scale for standards, but it does so in a way that turns the standard into a rule. *See* Holmes, *supra* note 7; Anthony Niblett, *Case-by-Case Adjudication and the Path of the Law*, 42 J. LEGAL STUD. 303, 310 (2013).

19. *See, e.g.*, RAZ, *supra* note 2; FREDERICK SCHAUER, PLAYING BY THE RULES: A PHILOSOPHICAL EXAMINATION OF RULE-BASED DECISION-MAKING IN LAW AND IN LIFE (1991); *see also* Kaplow, *supra* note 1, at 609 (discussing institutional competence generally).

20. *See generally* DANIEL KAHNEMAN, THINKING, FAST AND SLOW (2013); Christine Jolls, Cass R. Sunstein & Richard Thaler, *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471, 1523–27 (1998); Jeffrey J. Rachlinski, *A Positive Psychological Theory of Judging in Hindsight*, 65 U. CHI. L. REV. 571 (1998).

21. *See, e.g.*, Jeffrey J. Rachlinski, Sheri Lynn Johnson, Andrew J. Wistrich & Chris Guthrie, *Does Unconscious Racial Bias Affect Trial Judges?*, 84 NOTRE DAME L. REV. 1195 (2009) (finding evidence of judicial bias based on race); *see also* Christine Jolls & Cass R. Sunstein, *The Law of Implicit Bias*, 94 CAL. L. REV. 969 (2006) (discussing implicit biases that individuals hold against disadvantaged groups).

22. *See, e.g.*, Thomas J. Miles & Cass R. Sunstein, *The New Legal Realism*, 75 U. CHI. L. REV. 831 (2008) (finding that political preference, race, gender, and other demographic characteristics sometimes have effects on judicial judgments); Anthony Niblett, *Tracking Inconsistent Judicial Behavior*, 34 INT'L REV. L. & ECON. 9 (2013) (finding that judges in California decide unconscionability cases inconsistently with precedent). *See generally* Jeffrey A. Segal, *Judicial Behavior*, *in* THE OXFORD HANDBOOK OF POLITICAL SCIENCE 275 (Robert E. Goodin ed., 2011). It has been argued that these flaws of judges may be partially responsible for the increased flight to agency regulation over the past twenty to thirty years, in spite of the

unbiased.[23]

Ex ante lawmakers and regulators may, of course, also be biased.[24] But the biases exhibited in ex post adjudication are particularly costly. Hindsight bias is more pervasive and difficult to minimize for ex post adjudication. Additional biases based on personal characteristics of an individual are also more likely for ex post adjudication and may be particularly pernicious and harmful to social objectives.[25] The presence of biased adjudicators, thus, alters the error-cost trade-offs between rules and standards and weakens any claims that standards have lower error costs.

A third cost comparison is also relevant when assessing the relative merits of rules and standards: the uncertainty cost imposed on the regulated actor in understanding whether her behavior complies with the law. Uncertainty about the content of a law is greater with standards than with simple rules. When regulated by a simple rule, an individual will more likely know whether her behavior is allowed or prohibited.[26] When regulated by a standard, on the other hand, the individual does not know how any particular judge with wide discretion will apply the standard to the facts. She may not know what behavior a judge will consider reasonable.

The choice between using a rule or a standard to achieve a particular policy objective is therefore a question of weighing and trading off these costs. We predict that advances in technology will fundamentally change that trade-off.

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many well-recognized and well-documented flaws of regulators and economic costs of regulation. ANDREI SHLEIFER, THE FAILURE OF JUDGES AND THE RISE OF REGULATORS (2012); *see also* Joshua Schwartzstein & Andrei Shleifer, *An Activity-Generating Theory of Regulation*, 56 J.L. & ECON 1 (2013) (modeling the choice between ex ante regulation and ex post judging where courts commit errors).

23. *See generally* KAHNEMAN, *supra* note 20; Jolls & Sunstein, *supra* note 21, at 970–71; Rachlinski et al., *supra* note 21, at 1201–04 (exploring the effects of unconscious or implicit biases).

24. *See, e.g.*, Stephen M. Bainbridge, *Mandatory Disclosure: A Behavioral Analysis*, 68 U. CIN. L. REV. 1023, 1056–58 (2000) (noting the lack of attention to the behavioral biases of regulators); Stephen J. Choi & A.C. Pritchard, *Behavioral Economics and the SEC*, 56 STAN. L. REV. 1, 20–36 (2003) (cataloguing the biases affecting SEC regulators).

25. For our purposes, the important observation will be that machine-created rules are less likely to be biased than humans in making rules or applying standards. Our analysis suggests that given a legislative goal, machines will more faithfully implement that objective. *See infra* Part II. It is possible, still, that judges are debiasing bad legislative policy (though some empirical evidence suggests otherwise). In that case, judges have the power to override and influence policy in a way that may be socially beneficial. That power will be lost as standards die. We address these issues in Part III.

26. This assumes that judges (and juries) follow rules. They may, however, import exceptions that turn rules into standards—or ignore the rules altogether. *See* Schauer, *supra* note 3, at 312–14. For the most part we bracket the possibility of such rule nullification. But it is worth noting that the developments we explore make nullification less likely as well. *See infra* Part III.A (discussing the diminished capacity for judges to influence and change legal substance and policy). This is yet another way that law will become more rule based from the perspective of the regulated individual.

B. Technology Will Facilitate the Emergence of Microdirectives as a New Form of Law

Two types of technology will lead to the death of rules and standards and the rise of microdirectives: *predictive technology* and *communication technology*. The first will facilitate lawmakers' efforts to craft precise ex ante context-specific rules that provide the nuance and specificity traditionally associated with standards. The second will allow for the translation of those nuanced and specific laws into simple directives that are communicated to the regulated actors in a timely manner.

Predictive Technology. Predictive technology, driven by ever increasing computational capacity, will allow lawmakers to sculpt more perfect ex ante laws.[27] Computation power is growing at exponential rates. The consistent trend of the last fifty years suggests that that power will, by the end of this century, be more than one trillion times greater than what it is today.[28] With even a fraction of that processing power, tomorrow's computers will be able to gather and analyze more facts than any human lawmaker or judge. Lawmakers will be able to direct a machine to analyze a massive amount of data instantly to predict which rules can precisely achieve a policy objective.

Relying on the machines to observe and analyze more relevant facts, lawmakers will make better predictions about the impact of a law and will face reduced error costs. Lawmakers will no longer have to think up rules to enact laws. Judges will no longer have to examine citizens' decisions on a case-by-case basis in order to apply laws. And the laws will be highly calibrated to policy objectives with no chance of judges introducing bias or incompetence. Of course, the calibration need not be perfect, it only needs to be better than the calibration associated with the alternatives of legislated rules and adjudicated standards.

As a practical matter, the result will be a new hybrid form of law that is both rule and standard. The lawmaker can set a broad objective, which might look like a standard. But the predictive technology will take the standard and engineer a vast catalog of context-specific rules for every scenario. But that is only the first half of the story.[29]

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27. In a different context, Professor Michael Abramowicz identified the power of predictive decision making to "take[] advantage of the best of both the world of standards and the world of rules." Michael Abramowicz, *Predictive Decisionmaking*, 92 VA. L. REV. 69, 74 (2006). Our analysis is consistent with and builds on Abramowicz's important insight. When the power of prediction that he identified is harnessed and amplified by technological advances and coupled with new communication technologies, the law-making process fundamentally changes.

28. *See infra* Part II.A.2. This estimate is based on a trend known as Moore's Law. *See generally* Mark Lundstrom, *Moore's Law Forever?*, 299 SCIENCE 210, 210 (2003) (explaining Moore's Law and its implications for electronic systems); McGinnis & Wasick, *supra* note 1, at 1041 (describing Moore's Law); Gordon E. Moore, *Cramming More Components onto Integrated Circuits*, ELECTRONICS, April 19, 1965, at 114 (setting out the premise of Moore's law).

29. The discussion of predictive technology here and throughout this Article assumes a consequentialist approach to law. For a consequentialist, the content of the law is driven by a prediction of the outcome of behavior. For nonconsequentialist theories, the use of the technology is slightly different. But the trend toward microdirectives will likely be the same. For example, imagine that a lawmaker wants to prohibit certain behavior she deems immoral

Communication Technology. In the second half, the communication technology will simplify that context-specific catalog of rules into clear microdirectives for the regulated individuals. Without that simplification, the catalog of rules would be too complex and pose significant compliance challenges. It would be impossible for people to learn, remember, and process all of the requirements contained in the catalog. But advances in communication technology will produce microdirectives that reduce or eliminate those compliance costs and prevent uncertainty costs that might otherwise arise.

The mechanism for translation is straightforward. Communication technology will gather and transmit information about the scenario in which the individual finds herself,[30] identify the applicable rule from the vast catalog, and then translate that into a simple directive that is communicated back to the individual when she needs it. In this way, microdirectives will turn hundreds or thousands of context-specific, machine-generated rules into simple directives that are easy to understand and follow. The law controlling a particular scenario may take into account hundreds or thousands of factors,[31] but the individual will receive a simple command like a red or green light. When the output from the predictive technology is translated into a microdirective, citizens will be able to act *as if* they are taking into account more relevant factors than are humanly possible.[32]

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To summarize, these technologies will combine to do the following. First, they

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regardless of the consequences of that behavior. She does not want to list out all permutations of immorality, so a rule will not work. Instead, she can start with a standard—immoral activity is prohibited—and then identify samples of immoral behavior to feed into a machine. The machine can then use analytic and pattern recognition technology to determine whether other new scenarios would be deemed immoral by the lawmaker. We discuss below a similar process of pattern recognition for the question of pornography that a lawmaker knows is pornography when she sees it. *See infra* Part II.A.2.

30. We include this fact-gathering function in our analysis of communication technology because the key innovation is the communication of the factual scenario from the specific context to the analytic process. The technology facilitating this communication is likely to be the same or related to the technology facilitating the communication (in the other direction) of the final microdirective from the process to the individual.

31. To the extent that certain factors like race and gender are considered out-of-bounds, the machines can be programmed to ignore those factors. Indeed, it is easier for a machine to affirmatively ignore a prohibited factor than for a human.

32. These microdirectives share some important characteristics with McGinnis and Wasick's "dynamic rules." McGinnis & Wasick, *supra* note 1, at 1039–45. Both can be very precisely calibrated to specific conditions. But McGinnis and Wasick envision that at least the algorithm is "fixed by a rule" that must be changed if the "world may change in a way that makes another weighting of factors achieve the legislature's original objectives." *Id.* at 1047–48. We suggest instead that one of the core functions of a microdirective is the ability to learn from data and automatically update the weighting of factors the way a judge would update her application of a standard. In this way, microdirectives are not rules. They update automatically and continuously to account for such changes in the weighting of factors. But unlike standards they can be communicated ex ante with certainty.

will take a standard-like policy objective, analyze its application in all possible contexts, and create a vast catalog of legal rules—each of which is tailored to best achieve the objective in a specific scenario. Second, when a regulated actor is in any actual scenario, the technologies will search the vast catalog and identify the specific rules that are applicable. Third, they will translate those rules into a simple microdirective on how the regulated actor can comply with the law. Fourth, they will communicate that microdirective to the regulated actor in a timely and efficient manner.

C. Examples

To demonstrate the point, we present two stylized examples.

1. Example 1: Predictive Technology in Medical Diagnosis

In this subsection, we provide an example that demonstrates how improved *predictive technology*—technology that allows lawmakers to better predict the outcomes of actions—will foster microdirectives.

Suppose you are a legislator. You are charged with determining when doctors should be liable for performing a risky surgery on a patient. How can you best regulate doctors' behavior? How can you best draft a statute that will help doctors understand when their behavior complies with or violates the law? How many of the specific details should you include in the statute? How many of these details can be postponed until we have more information about how doctors behave in each case?

One option is to provide doctors with a clear and simple bright-line rule that dictates the circumstances under which surgery should or should not be conducted. This simple rule provides great certainty to the doctors and is easily enforced; either a doctor complied with the rule or she didn't. A simple, precise ex ante rule would be your preferred method if similar patients frequently present with the same symptoms.[33] Under these circumstances, a rule would be preferred because the content of the law can be established just once, and there are enormous benefits from economies of scale.

But a doctor's decision to operate on a patient frequently turns on many different factors. A "one size fits all" rule here would likely not be optimal. Any simple bright-line rule you enact will likely be overinclusive and underinclusive compared to an optimal decision rule. There will be some patients who receive surgery who do not need it (type I errors); there will also be other patients who do not receive surgery who do need it (type II errors).

To overcome these errors, you may try to write a more complex rule. To formulate this rule, you may try to think up many different scenarios, where you imagine different types of patients presenting with various symptoms. A complex rule is preferred if the cost of thinking and writing the rules is very low *and* the cost of doctors understanding and being able to comply with such a complex rule is also low. But it is often very costly for legislators to think up and write down all contingencies.

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33. *See* Kaplow, *supra* note 1, at 573–77 (discussing the importance of frequency in assessing the desirability of rules).

Further, the more complex the rule you write, the more difficult it becomes for a doctor to follow.[34]

Rather than implement a rule, another option you have is to enact a *standard* and evaluate the conduct of a doctor after the decision to operate (or not operate) has been made. That is, the decision to hold a doctor liable would be made once all the circumstances of the particular case are known.[35] For example, the legal standard might stipulate that all doctors must take "reasonable care" in determining whether to operate on patients. This provides doctors with greater flexibility to decide whether or not the patient needs surgery.[36] But it also provides an ex post adjudicator with the flexibility and discretion to determine what is meant by "reasonable."

If a patient suffers harm as a result of a doctor's decision, then a judge can look at all the facts as they actually occurred and make an informed decision as to whether the doctor took reasonable care. A standard would be better than a rule if patients and symptoms are heterogeneous and the likelihood of two patients with the same background and symptoms is very low.

There are, of course, costs associated with implementing and enforcing a standard. First, the cost of deciding each case is not zero. There are decision costs of learning the best course of action the doctor should have taken in the circumstances. Second, a judge may apply the standard incorrectly, either due to error or to bias. Third—and importantly—unlike a clear rule, a vague standard creates a great deal of uncertainty for the doctor. A doctor may not know how a judge will decide any given case; further, different judges may decide inconsistently. If doctors are risk averse, a vague law can chill socially desirable behavior,[37] and the uncertainty may generate considerable expense in the form of compliance costs.

But in our hypothetical situation, let's suppose that a standard is optimal. Let's assume that the question of surgery rarely arises and that patients are highly diverse, both in terms of health backgrounds and in terms of the symptoms they present. Formulating detailed rules that cover all those situations and being able to communicate these complex rules to doctors would be difficult, and a simple rule would create high error costs. Case-by-case adjudication is not costless but it is preferred in our example because the infrequent cost of determining the content of the law ex post is

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34. Louis Kaplow, *A Model of the Optimal Complexity of Legal Rules*, 11 J.L. ECON. & ORG. 150, 151 (1995) (modeling the trade-off between complexity and regulated actors' ability to comply); *see also* Diver, *supra* note 3, at 73–74 (noting the trade-off between precision and ease of applying and following a law).

35. As Henry Hart and Albert Sacks note: "The wise draftsman . . . asks himself, how many of the details of this settlement ought to be postponed to another day, when the decisions can be more wisely and efficiently and perhaps more readily made?" HENRY M. HART, JR. & ALBERT M. SACKS, THE LEGAL PROCESS: BASIC PROBLEMS IN THE MAKING AND APPLICATION OF LAW 157 (1958).

36. *See* John Braithwaite & Valerie Braithwaite, *The Politics of Legalism: Rules Versus Standards in Nursing-Home Regulation*, 4 SOC. & LEGAL STUD. 307 (1995). After comparing nursing homes in rule-based United States and standard-based Australia, Braithwaite & Braithwaite conclude that the flexibility of standards in Australia allows health care professionals to respond to their patients' needs better than professionals merely applying strict rules. *Id.*

37. *See* Craswell & Calfee, *supra* note 6, at 298–99 (concluding that uncertainty can reduce socially desirable behavior).

lower than the costs of trying to specify the law up front in all potential situations, many of which will never arise.

Now let's examine how technology will eliminate this trade-off between rules and standards. Suppose that you learn of the existence of a diagnostic machine that is designed to predict when surgery is required. The machine takes into account relevant facts about the patient[38]—her history, the symptoms, and other relevant information—to provide a best guess as to whether the patient requires surgery.

You, the legislator, have access to this machine. How does this predictive machine affect your decision to enact a rule or a standard? The answer turns on two factors. First, how good is the machine at accurately predicting outcomes? If the predictive technology is very powerful and the machine is able to provide precise and accurate information, then this points in favor of using the machine to create a rule, rather than relying on a judge to adjudicate a standard. Second, can this information be easily communicated to a doctor? That is, can lawmakers provide the doctor with timely notice of what behavior will comply with or violate the law?

Consider two scenarios:

> *Scenario 1: A terrible predictor*
>
> In scenario 1, the machine is very poor at predicting when a patient requires surgery. The machine essentially randomizes patients for surgery. The machine generates both type I and type II errors. One might think of the technology as a simple coin toss: heads for surgery, tails for no surgery.

> *Scenario 2: A perfect predictor*
>
> In scenario 2, the machine can predict with 100% accuracy whether a patient requires surgery or not. The machine instantly examines the patient's history and symptoms, analyzes millions of prior cases, and reads all articles in medical journals. It then makes a perfect prediction. It is better than any human at determining whether it is optimal to have surgery. There are no type I errors: patients who do not need surgery are not designated for surgery. There are no type II errors: patients who need surgery are designated for surgery.

Under scenario 1, the technology should have no effect on your decision as a regulator to implement a rule or a standard. You should implement a standard and determine liability on a case-by-case basis, learning more about doctors' behavior over time.

Under scenario 2, however, the optimal form of the law will be different. The machine's predictions provide the exact content of the law. The machine provides microdirectives for each and every scenario. The over- and underinclusivity associated with simple rules have disappeared. There are no errors (type I or type II) in this scenario. And the costs incurred in thinking up and formulating such a complex rule have already been incurred in the development of this machine.[39] The justification

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38. In practice, the machine would actually take into account relevant information about the doctor as well, such as his track record with surgeries of the relevant type.

39. In reality many of the costs for developing the machine may have been incurred by

for relying on ex post adjudication of standards—reducing the error costs of rules—is gone. Further, we have an added benefit of eliminating uncertainty for the doctors. If they follow the directive of the machine, they know they will not be held liable.

The emergence of microdirectives and the death of rules and standards as we know them do not rely on *perfect* predictive technology. Rather, as the predictive technology gets better and better, we move away from the world of scenario 1 and towards the world of scenario 2. There will come a point where the technology is *good enough* that the costs of using a microdirective are sufficiently low so that there is no longer any need to use traditional rules or standards.

A caveat is necessary. This tipping point can only be realized if the rules generated by the machine can be easily communicated to doctors. That is, the legislator has to be able to provide the doctor with a quick and simple answer to the question of whether the patient requires surgery.

Doctors would find it difficult to follow complex, computer-derived rules. Regulated actors have neither the desire nor the time to thumb through thousands of pages of legislation and understand complex algorithms. Rather, lawmakers need some form of technology to allow a doctor to easily input all the relevant facts about a patient and receive an instant output that dictates whether or not the patient requires surgery. One might imagine a web-based program or mobile app, where the doctor can quickly and easily enter all relevant facts, submit the information, and instantly receive a binding ex ante opinion. Such technology is emerging and will be able to transform the complex rules generated by machine prediction into a simple directive that the doctor can follow.[40] The costs to the doctor in understanding the complex rule will be dramatically reduced as this technology improves. Even though the rule will be highly complex and based on a sophisticated algorithm, from the perspective

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industry for the nonlegal benefits that the machine brings. In that sense, the marginal costs of using it for law are negligible. Moreover, even if the machine had to be developed specifically for law, that is a fixed cost that can be averaged across all applications when calculating the per rule cost.

40. *See, e.g.*, Robert McMillan & Elizabeth Dwoskin, *IBM Crafts a Role for Artificial Intelligence in Medicine*, WALL ST. J. (Aug. 11, 2015, 12:04 AM), http://www.wsj.com/articles/ibm-crafts-a-role-for-artificial-intelligence-in-medicine-1439265840 [https://perma.cc/DXL7-TUWG] (describing IBM's planned move into artificially intelligent diagnostics for cancer and other diseases); Joseph Walker, *Can a Smartphone Tell if You're Depressed?*, WALL ST. J. (Jan. 5, 2015, 7:03 PM), http://www.wsj.com/articles/can-a-smartphone-tell-if-youre-depressed-1420499238 [https://perma.cc/6AWE-C4AU] (describing tests of a new generation of "health-surveillance technologies" that can gather information to diagnose illness and assess physical and mental well-being); Ron Winslow, *Patients Seeking Alternatives to Statins May Undergo Rigorous Vetting,* WALL ST. J. (July 27, 2015, 4:40 PM), http://www.wsj.com/articles/patients-seeking-alternatives-to-statins-may-undergo-rigorous-vetting-1438029636 [https://perma.cc/79SD-9EDM] (describing a software application that guides doctors through the decision to put patients on nonstatin cholesterol treatment). *See generally* William M. Grove & Paul E. Meehl, *Comparative Efficiency of Informal (Subjective, Impressionistic) and Formal (Mechanical, Algorithmic) Prediction Procedures: The Clinical-Statistical Controversy*, 2 PSYCH., PUB. POL'Y & LAW 293 (1996) (noting how simple formal algorithms frequently outperform human predictions).

of the doctor, the rule will be simple: operate or do not operate.[41] We explore communication technology further in our second example.

2. Example 2: Communication Technology in Traffic Laws

In this subsection, we highlight the way improved *communication technology* will facilitate microdirectives. Machines can almost instantaneously gather information, process it, and produce a useable output that directs how individuals should behave.

Traffic lights provide an example of this type of technology. They communicate the content of a law to drivers at little cost and with great effect. This notice technology—combined with technology for predicting traffic patterns and driver behavior—creates an environment where lawmakers are able to replace vague standards and simplistic rules with crisp and increasingly complex microdirectives.

Electric traffic lights communicate to drivers precisely when they are required to stop and when they may proceed. Traffic lights appear to generate very simple rules: if the light is red, you must stop; if the light is green, you may go. But these rules are simple only from the perspective of the driver. From the perspective of the lawmakers, the underlying rules are complex. The simplest underlying rule may dictate that cars must stop during regular, alternating time intervals. In more complex examples, the time intervals can vary by intersection, direction of traffic, or time of day.

If promulgated without traffic lights, these rules would be far too complex. Drivers would have to consult tables that matched intersections, times, and directions with prescribed intervals of stopping. They would also have to consult precise clocks to determine when the intervals start and end.

The traffic light translates complexities into a simple command. From the driver's point of view, the lights provide a directive that is easily understood. And the lawmaker's cost of giving notice is low.[42] Electric traffic lights take advantage of significant economies of scale that enable lawmakers to make complex rules, translate them into simple directives, and deliver notice of the required behavior to many drivers.

Moreover, while the command of the traffic light remains simple, the substance of the underlying rules is becoming more complex. Predictive analysis facilitates this process. Stopping at a red light when an intersection is deserted is wasteful and

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41. It may seem odd at first that lawmakers are in the business of diagnostic technology. But this is no different from what judges do in medical litigation. Judges hear expert testimony and decide ex post whether certain behavior was reasonable. In our example, lawmakers just use expert technology to do that ex ante. It is true that the role of the doctor has changed—diagnostic judgment is less important—but that is the inevitable result of advances in diagnostic technology. Our point is simply that in the hands of lawmakers the technology also changes the role of law. When the technology is only available to the private actors—the doctors in this example—then the evolution of rules into standards takes a slightly different path. We discuss this *infra* Part I.D.

42. These stop-go rules would be far more costly if humans operated traffic lights. Indeed, the first gas-powered traffic light used in 1868 in London, United Kingdom, was operated by humans. *The Man Who Gave Us Traffic Lights*, BBC: NOTTINGHAM (last updated July 22, 2009, 11:57 AM), http://www.bbc.co.uk/nottingham/content/articles/2009/07/16/john_peake_knight_traffic_lights_feature.shtml [https://perma.cc/4M28-DWR7].

costly.[43] That rule is overinclusive. It would be better if the directive to the driver could change depending on the circumstances (as it would with a standard). To address this, traffic lights in some jurisdictions already contain sensors that detect and predictively analyze traffic flow and adjust the timing of red and green lights accordingly.[44] Some traffic lights contain detectors allowing emergency service vehicles to "preempt" the signal and expedite their journey.[45] In the near future, these systems will take into account more variables, such as the number of cars, speed of travel, or type of intersection. They might even take into account personal characteristics of a vehicle's driver or passengers.[46] In the not-so-distant future, a traffic-light system may know that a passenger in a regular vehicle requires medical attention and give the rushing driver a series of green lights all the way to the hospital.

The progress of traffic lights shows how lawmakers can define optimal policy outcomes (for example, travel times and accident rates) and machines can generate a catalog of rules and exceptions to achieve those outcomes. And yet—even while the lawmakers enact a standard and the machines generate an increasingly complex catalog of rules underpinning the operation of traffic lights—from the perspective of the driver, the law will remain constant and straightforward: a simple stop-go directive.

This phenomenon is not limited to traffic law. The forces at work here are ubiquitous. The invention and mass adoption of Internet technology has facilitated instantaneous and cheap communication between individuals across all domains.[47] It also, importantly, allows for immediate communication between lawmakers and individuals.

D. The Different Channels Leading to the Death of Rules and Standards

We have, until now, spoken generally of lawmaking by a legislature. That is by no means the only avenue. Microdirectives can emerge through two other channels: (1) nonlegislative (regulatory or judicial) law making; and (2) private use of technology by regulated actors.[48] We discuss each in turn.

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43. There are other potential costs such as the increase in the number of rear end traffic accidents caused by cars braking as lights turn yellow. We argue that these costs will also die out as the rule becomes more context specific.

44. *See, e.g.*, Ian Lovett, *To Fight Gridlock, Los Angeles Synchronizes Every Red Light*, N.Y. TIMES (Apr. 1, 2013), http://www.nytimes.com/2013/04/02/us/to-fight-gridlock-los-angeles-synchronizes-every-red-light.html [https://perma.cc/SS66-29A7] (describing Los Angeles's $400 million system of synchronized traffic sensors aimed at controlling traffic flow and reducing gridlock); *see also* Diane Cardwell, *Copenhagen Lighting the Way to Greener, More Efficient Cities*, N.Y. TIMES (Dec. 8, 2014), http://www.nytimes.com/2014/12/09/business/energy-environment/copenhagen-lighting-the-way-to-greener-more-efficient-cities.html [https://perma.cc/3F2D-YS68] (noting Copenhagen's use of lights and sensors aimed at easing mobility and cutting use of fuel as well as achieving more ambitious goals).

45. U.S. DEP'T TRANSP., TRAFFIC SIGNAL PREEMPTION FOR EMERGENCY VEHICLES A CROSS-CUTTING STUDY 1-1 (2006), http://ntl.bts.gov/lib/jpodocs/repts_te/14097_files/14097.pdf [https://perma.cc/9SDF-BRC8] (noting the signal preemption programs in various jurisdictions).

46. *Cf.* Porat & Strahilevitz, *supra* note 12 (noting the value of personalized laws).

47. *See infra* Part II.

48. Here, we discuss different channels through which technology will affect the law. In

1. The Production of Microdirectives by Nonlegislative Lawmakers

Legislatures are not the only lawmakers with access to technology. In many cases, the lawmaking power is entrusted to a regulator or enforcement agent.[49] In other cases, judges make law. Those entities can also use technology to create and communicate microdirectives to regulated actors.

Regulatory microdirectives. It is likely to be more politically feasible for regulators to develop microdirectives than legislators. The legislative path to enacting a computer algorithm is complicated. Pork barrel and horse-trading amendments to an algorithm do not make for successful programming. On the other hand, a regulator tasked with enforcing some legislated standard might easily adopt an algorithm-driven system of microdirectives.[50]

The pressures on a budget-constrained regulatory body will push the agency toward adopting technology. Likewise, trends towards cost-benefit analysis and requirements that regulations be shown to be cost justified[51] are likely to accelerate agency adoption. Predictive technology facilitates such cost-benefit analysis, reduces uncertainty costs to the regulated actors, and cuts down on ex post adjudication costs.

Congress could enact a standard and direct that these standards be administered by an algorithm-based system of microdirectives overseen by regulators or the regulators could themselves decide to implement the standard in that manner.[52]

Advance tax rulings provide an example of an area for regulators to use microdirectives.[53] As it currently stands, taxpayers may seek clarification of vague standards in the law by asking the tax authority to examine their tax arrangements and determine whether they comply with the code.[54] A taxpayer may ask the tax authority to give a ruling on a matter that takes into account a number of factors such as: Am I a resident of the United States for tax purposes? Or, are my workers independent contractors or are they employees?[55]

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other work, we have discussed the incremental nature of these changes. *See* Anthony J. Casey & Anthony Niblett, *Self-Driving Laws*, 66 U. TORONTO L.J. 429 (2016).

49. From the legislature's perspective, the delegation to an agency or enforcer takes the form of a standard. *See* Schauer, *supra* note 3, at 310. The legislature sets a broad goal and gives the agency the power to fill the content of rules.

50. McGinnis & Wasick, *supra* note 1, at 1042 (discussing the use of algorithms by rule makers); *cf. id.* at 310–12.

51. *See generally* CASS R. SUNSTEIN, THE COST-BENEFIT STATE: THE FUTURE OF REGULATORY PROTECTION (2002) (exploring the rise of cost-benefit analysis in administrative agencies).

52. This is not the same as traditional convergence predictions where rules become standards or standards become rules. Schauer, *supra* note 3, at 310–12. With microdirectives, laws take a new form that has some of the benefits of rules (more certainty) and some of the benefits of standards (better calibration) but fewer of the costs associated with either.

53. *See generally* CARLO ROMANO, ADVANCE TAX RULING AND PRINCIPLES OF LAW (2002); Yehonatan Givati, *Resolving Legal Uncertainty: The Unfulfilled Promise of Advance Tax Rulings*, 29 VA. TAX. REV. 137, 144–47 (2009) (describing how advance tax rulings reduce uncertainty).

54. 26 C.F.R. § 601.201 (2017); Givati, *supra* note 53, at 149–52 (outlining the process and implications of obtaining an advance tax ruling).

55. ROMANO, *supra* note 53, at 80.

These advance tax rulings bind the tax authority to the tax arrangements set out in the ruling, but only for the one specific taxpayer.[56] Essentially the taxpayer is asking the tax authority to turn an ex post standard into a specific rule that applies solely to her circumstances. These advance rulings have a variety of benefits. Most prominently, they provide greater legal certainty to the taxpayer.[57] They eliminate the uncertainty costs of the standard.[58] But such rulings can be costly to generate.[59] The tax authority is essentially engaged in personalized rule making. It is incurring high ex ante decision costs by enacting a rule that applies to just one taxpayer.[60]

Now imagine the tax authority could create a system where a taxpayer simply turns to a machine to answer her tax questions. She could, for example, turn to an agency website or a mobile app. She could ask the machine whether her tax arrangements will expose her to liability and the machine could quickly read the entire tax code, all relevant cases, all associated regulations, and all relevant advisory opinions. The machine could immediately provide an answer to the taxpayer's question.[61]

The tax authority, thus, could use this artificially intelligent machine to provide advance tax rulings. Depending on the underlying objective of the legislature, the tax authority could use the machine to identify optimal rules that allow it to generate more revenue with greater efficiency and fewer distortions on market behavior. It could use this technology very broadly to choose very specific rules that are highly calibrated to legislative objectives without introducing compliance costs that would otherwise be associated with such complexity.

If regulators adopt these technologies, the answers provided by the tax authority would essentially become the red or green lights of tax law. Even though the underlying tax laws would be very complex, the directives provided to an individual would be simple. Any enforcement agent could adopt technology of this kind.[62] As

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56. In the United States, these rulings ("private letter rulings") are "binding on the IRS if the taxpayer fully and accurately described the proposed transaction in the request and carries out the transaction as described." *Understanding IRS Guidance—A Brief Primer*, IRS (last updated July 6, 2016), https://www.irs.gov/uac/Understanding-IRS-Guidance-A-Brief-Primer [https://perma.cc/RGV3-APFP]; *see also* 26 C.F.R. § 601.201(a)(1)–(2), (l); Givati, *supra* note 53, at 149–50.

57. ROMANO, *supra* note 53, at 77–78.

58. Givati, *supra* note 53, at 147.

59. ROMANO, *supra* note 53, at 277–80.

60. *See* Givati, *supra* note 53, at 149. As a formal matter, the rulings only resolve the relationship between the tax authority and one specific taxpayer. Further, they have no formal precedential effect for future taxpayers. As a practical matter, however, the tax authority is required to treat taxpayers consistently and so a de facto precedential value arises—but this does not rise to the level of a binding rule for all future cases. *Id.* at 158–61 (discussing the nuances of the precedential value of advance rulings and surveying the legal scholarship on the matter).

61. For more on this process, see Benjamin Alarie, *The Path of the Law: Towards Legal Singularity*, 66 U. TORONTO L.J. 443 (2016); Benjamin Alarie, Anthony Niblett & Albert H. Yoon, *Using Machine Learning to Predict Outcomes in Tax Law*, 58 CANADIAN BUS. L.J. 231 (2016).

62. The Securities and Exchange Commission has a program similar to advance tax rulings where it provides "no-action" letters that state that the staff will not recommend enforcement actions against the individual or entity seeking guidance. The letter has no binding effect on other individuals or entities, and the SEC reserves the right to change its

predictive technology makes it easier to automate such regulatory advance rulings and ensure their accuracy, they will become a common mechanism for the adoption of machine-generated microdirectives.[63]

Judicial microdirectives. Aside from the legislator and the regulator, there is, of course, a third potential rule maker: the judge. But, as they currently function, judges do not quite fit into this model of law making. To be sure, judges could use artificial intelligence and big data to apply standards or complex rules.[64] But judges are not—at least in a formal sense—regularly in the business of providing ex ante notice of the outcomes of hypothetical scenarios.

For better or worse, advisory opinions are frowned upon by the American judicial system. Judges might use the predictive technology to refine the law ex post. But without notice to the regulated actors, those specific rulings impose some of the same costs as standards. For example, if judges announce that all negligence cases will be decided using a computer algorithm,[65] a regulated actor without access to the algorithm would still be faced with nothing more than a standard that imposes uncertainty

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position. *See No Action Letters*, U.S. SEC. & EXCHANGE COMMISSION, http://www.sec.gov/answers/noaction.htm [https://perma.cc/HP8Q-WCWB] (last updated Sept. 21, 2012). *See generally* Donna M. Nagy, *Judicial Reliance on Regulatory Interpretations in SEC No-Action Letters: Current Problems and Proposed Framework*, 83 CORNELL L. REV. 921 (1998) (describing the no-action letter process).

63. There will be some areas in law where the provision of advance directives is problematic. Tax provides a salient example. For some things, the lawmaker and the individual have aligned incentives. The individual wants to comply with the lawmaker's policy objectives and certainty makes compliance more likely. But for other things, the individual wants formal compliance with law but would prefer to avoid the policy objective. In other words, the individual is looking for a loophole. If the law provides a clear rule and the regulated individual would prefer to circumvent that rule, then certainty provides a road map for avoidance. *See* David A. Weisbach, *Formalism in the Tax Law*, 66 U. CHI. L. REV. 860, 882–84 (1999) (describing the use of "anti-abuse" standards to deal with rule avoidance).

In these spaces, it is difficult to predict how microdirectives will fair. On the one hand, the use of microdirective technology to craft a precise law may shrink the space for avoidance. After all, a perfectly calibrated law will provide no space for avoidance. On the other hand, if the law has any imperfection and the regulated individual has superior private technology, she may use the technology to find the imperfections and craft her behavior (such as creating elaborate tax avoidance mechanisms) to avoid application of the microdirective. These arms race scenarios—where avoidance creates private benefits and private technology is in competition with the lawmakers' technology—suggest areas where standards, such as the anti-abuse standard, will survive to supplement microdirectives. Still, the problem could be solved without standards. Revelation of the microdirective could simply be delayed until immediately after the regulated individual took action. This prevents evasion but also commits the government to the rule ahead of time to avoid bias. On the general idea of delaying the revelation of rules to prevent evasion, see Saul Levmore, *Double Blind Lawmaking and Other Comments on Formalism in the Tax Law*, 66 U. CHI. L. REV. 915 (1999).

64. *Cf.* Porat & Strahilevitz, *supra* note 12, at 1436 ("Under certain circumstances, we want the courts (and advocates in the courtroom) to embrace the science of Big Data as a means of deciding what terms ought to be imported into an ambiguous contract or will.").

65. The hypothetical scenario is not as fanciful as it may sound. The algorithm here is just a more precise amalgamation of the expert opinions that courts routinely rely on in deciding cases.

about how the judges will apply that standard. It would make little difference to the individual that the actual judge happens to be a computer.[66]

Things change if the regulated actors have access to the algorithm that judges will use. In that world, the regulated actors can predict the outcome with precision. If judges commit to using a certain technology that is available to the public, that would be equivalent to providing advance rulings.[67] This would essentially shift the judge's role to that of ex ante regulators. While not implausible, we think the avenues of legislative and regulatory rulemaking will be more pervasive.

There is another way that judges could be involved in the promulgation of micro-directives. Just as legislatures could set a broad policy objective and delegate the rule making to an agency, so too could the courts. In deciding cases, courts can announce a standard that blesses any rule that results from a process aimed at the correct policy objective and that takes into account the relevant factors. The agency could then create an algorithm that does exactly that. This "second-order regulation" by the court would send a message to the agencies on how to design the algorithm to ensure compliance.[68] Here again it would be the agencies and enforcers who have the ultimate responsibility for implementing the machine algorithm to promulgate microdirectives.

2. An Alternative path: Private Use of Technology by Regulated Actors

Predictive technology will be available to private actors. And, in some cases, private actors may have more advanced proprietary technology than legislatures, regulators, or courts.[69] Private use of predictive technology will lead to the emergence of microdirectives. There are two main ways this can occur.

The first path is through the interplay of reasonableness, industry standards, and technology. In our medical example above, imagine that the machine that predicts medical outcomes is available not to lawmakers but only directly to doctors. As the

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66. It is worth noting that ex post error and inconsistency costs are likely to be lower if the judge is using the algorithm. See the example of bail, *infra* Part II.A.2.

67. In a slightly different but related context, one commentator has suggested that judges could bind themselves to textualist interpretations of statutes by using computers to derive the meaning of text. Betsy Cooper, *Judges in* Jeopardy!*: Could IBM's Watson Beat Courts at Their Own Game?*, 121 YALE L.J. FORUM 87 (2011), http://yalelawjournal.org/forum/judges-in-jeopardy-could-ibms-watson-beat-courts-at-their-own-game [https://perma.cc/8DDC-ZC9L].

68. *See* John Rappaport, *Second-Order Regulation of Law Enforcement*, 103 CALIF. L. REV. 205, 214 (2015) (defining a second-order judicial decision as one that "states its obligations in terms of ultimate goals that must be achieved. The [agent] is then free to achieve those goals in any appropriate way" (quoting STEPHEN BREYER, REGULATION AND ITS REFORM 105 (1982))). This can be done for all standards including those that the court applies pursuant to the Constitution. *See infra* Part III. Rappaport's example of the court's second-order regulation of Fourth Amendment searches, Rappaport, *supra*, at 220–22, is an area where the death of rules and standards will be swift. Machine algorithms will be able to easily determine probable cause, exigent circumstances, bias of officers, and the like better than humans.

69. For example, private traders of securities have technology that permits higher frequency trading than regulators can observe and monitor in real time. *See* Eric Budish, Peter Cramton & John Shim, *The High-Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response*, 130 Q.J. ECON. 1547 (2015).

technology becomes more accurate we can expect more and more doctors to use it. At some point, it is likely that courts will begin to deem it *per se* unreasonable to *not* use such advanced technology. Imagine an orthopedic practice today that did not use an x-ray machine[70] or a colorectal specialist who refused to perform colonoscopies in diagnosing colon cancer.[71] As technology becomes more accurate and widespread, the likelihood that courts will base a reasonableness standard on the use of that technology increases. The proliferation of these technologies across industries will cause behavior that complies with standards to function exactly as if it were complying with a microdirective promulgated by the predictive technology.

The second path is a softer version of our main thesis. This path does not require lawmakers to use technology. Individuals can use predictive technology to provide predictions on how judges will apply a standard.[72] In this way, technology improves on the role of lawyers as compliance advisors.[73] When lawyers provide compliance advice, they are, in part, predicting how ex post adjudicators will apply a standard.[74] As computers can gather and analyze more and more prior cases, they will outperform lawyers at this task. On first blush, this advance would appear to reduce the compliance cost of standards. But it does so in a way that effectively turns the standard into a microdirective, as it reduces the costs of legal uncertainty because it tells the individual exactly how to behave. As Oliver Wendell Holmes noted, a prediction of a judicial outcome *is* the law.[75]

Advances in big data and artificial intelligence will spawn intelligent machines that can predict legal outcomes with great accuracy.[76] In our traffic example, imagine

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70. Doctors have frequently been held negligent for failing to order x-rays. *See, e.g.*, Rudick v. Prineville Mem'l Hosp., 319 F.2d 764 (9th Cir. 1963) (x-rays would have revealed fractured vertebrae); Webb v. Lungstrum, 575 P.2d 22 (Kan. 1978) (x-rays would have revealed small metal fragment in wound); Betenbaugh v. Princeton Hosp., 235 A.2d 889 (N.J. 1967) (negligence found where doctor failed to order x-ray of the injured part of the spine).

71. Doctors who failed to order a colonoscopy have been held negligent. *See, e.g.*, Morse v. Davis, 965 N.E.2d 148 (Ind. Ct. App. 2012).

72. McGinnis & Wasick, *supra* note 1, at 1033–39 (discussing the use of technology to predict judicial outcomes).

73. *See generally* Michele DeStefano Beardslee, *Taking the Business Out of Work Product*, 79 FORDHAM L. REV. 1869, 1874–81 (2011) (arguing that it is difficult to distinguish between business and law in corporate practice); Christine Parker*, Lawyer Deregulation via Business Deregulation: Compliance Professionalism and Legal Professionalism,* 6 INT'L J. LEGAL PROF. 175 (1999) (exploring the role of lawyers as compliance officers); Gregory J. Millman & Samuel Rubenfeld, *Compliance Officer: Dream Career?*, WALL ST. J. (Jan. 15, 2014, 8:13 PM), http://www.wsj.com/articles/SB10001424052702303330204579250722114538750 [https://perma.cc/E5AW-2Z54] (examining the rise of compliance officers).

74. On the law-and-economics of ex ante legal advice, see Louis Kaplow & Steven Shavell, *Private Versus Socially Optimal Provision of Ex Ante Legal Advice*, 8 J.L., ECON. & ORG. 306 (1992). *See also* Lynn M. LoPucki & Walter O. Weyrauch, *A Theory of Legal Strategy*, 49 DUKE L.J. 1405 (2000) (discussing the law-and-economics literature of legal culture and legal strategy).

75. Holmes, *supra* note 7, at 461 ("The prophecies of what the courts will do in fact . . . are what I mean by the law."); *see also* Abramowicz, *supra* note 27.

76. *See* Katz, *supra* note 11 (exploring the power of big data to predict legal outcomes); *see also* Porat & Strahilevitz, *supra* note 12, at 1436 (same).

that traffic is regulated only with yield signs that impose a reasonableness standard.[77] But in this world, consumer technology has advanced to a stage where it can predict when a court will deem yielding to be required under the standard. This private technology provides a mechanism for informing the driver when she must stop under the law. The technology gathers the relevant facts, applies the standard to those facts as a judge would, and provides predictive analysis.

Even though we have standards and private technology, the resulting behavior looks *as if* we had public traffic lights with underlying complex rules. And compliance is as simple for the driver as it would be with a microdirective. The driver simply gets a message saying stop. She does not have to even take mental note of the underlying facts. As technology makes ex post adjudication more predictable, citizens treat a prediction as a rule. They receive directives ex ante and have little uncertainty about how the law requires them to behave.

This may lead lawmakers to simply enact those predictions as law. It is possible, though, that lawmakers may deem fully predictable ex post adjudication to be the satisfactory equivalent of a microdirectives and not take the final step to formalize the microdirectives into law. But from the individual's perspective the transformation will be already complete. Drivers will know to stop when the technology in their car gives a signal—the equivalent of a red light.[78]

II. FEASIBILITY

In this Part, we examine the feasibility of using technology to generate microdirectives. This Part is divided in two main sections. First, we examine the feasibility of predictive technology. We look at examples where big data and artificial intelligence have been used to generate better predictions and insights than humans ever could provide, and we look to where the technology is headed. We look at how such predictive technology has dramatically diminished the need for human discretion.

Second, we examine the feasibility of communication technology. For the most part, this technology is already here and steadily improving. Mobile devices are becoming our first port of call for information. Individuals can easily and quickly communicate with other individuals, and—more importantly for our argument—lawmakers can easily and quickly communicate with regulated actors.

A. The Feasibility of Predictive Technology

There are two key takeaways from this section: (1) machines are, in many areas,

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77. *See, e.g.*, 625 ILL. COMP. STAT. 5/11-904(c) (West 2016) (requiring that a driver at a yield sign slow to "a speed reasonable for the existing conditions" and stop "if required for safety"); MASS. GEN. LAWS 89 § 9 (LexisNexis 2012) (same); Pierce v. Coltraro, 252 So.2d 550, 552–53 (La. Ct. App. 1971) (noting the standard that applies at a yield sign).

78. It is possible that judges, knowing about the predictive technology, will (consciously or unconsciously) respond by changing their behavior. If that were true, and assuming that advanced algorithms could not account for the changes when making predictions, that would suggest that technology for predicting judicial outcomes would lag behind other predictive technology in effectiveness. This alternative path toward the death of standards would, therefore, be less likely than the paths through legislative and regulatory rule making.

already better at predicting outcomes and behavior than any human; and (2) this technology is improving so rapidly that the superiority of machines in predicting outcomes will continue to grow at an exponential rate.

Machines can process billions of data points instantly to determine an optimal course of action. Even the most competent, objective humans cannot compete with algorithms generated by big data and artificial intelligence. We are producing and analyzing ever-increasing stores of data that will provide the backbone of predictive technology. It may be difficult to envision these longer-term trends, but as Bill Gates has noted: "We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten."[79] One can only imagine the extent to which we underestimate the change that will occur in the next twenty years, or by the end of this century.

In this section, we first explore how technological developments will improve the prediction of human behavior by better understanding and analyzing millions of hypothetical situations. We foreshadow the future growth of cognitive computing, artificial intelligence, and evolutionary algorithms to show how these powerful new technologies will facilitate the emergence of microdirectives. We then look at how human discretion is being replaced by computer-based rules in all professions and argue that law is no different.

1. The Power of Predictive Technology

Big data and artificial intelligence have reached a stage where likely outcomes can already be predicted in many aspects of human life.[80] By the end of the last century, computing machines were able to defeat the best grandmasters in chess.[81] A decade later, an artificially intelligent machine destroyed the grandmasters of the television trivia show *Jeopardy!*.[82] Indeed, machines outperform humans in many areas of life.[83] They can predict consumers' taste[84] and advise clients on financial

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79. BILL GATES, THE ROAD AHEAD 316 (1996).

80. *See generally* Katz, *supra* note 11.

81. In 1997, IBM's Deep Blue defeated Garry Kasparov 3½ games to 2½. For commentary on and descriptions of the match, see BRUCE PANDOLFINI, KASPAROV AND DEEP BLUE: THE HISTORIC CHESS MATCH BETWEEN MAN AND MACHINE (1997).

82. John Markoff, *Computer Wins on 'Jeopardy!': Trivial, It's Not*, N.Y. TIMES (Feb. 16, 2011), http://www.nytimes.com/2011/02/17/science/17jeopardy-watson.html [https://perma.cc/CM9S-7CQ4].

83. *See* MARTIN FORD, THE RISE OF THE ROBOTS: TECHNOLOGY AND THE THREAT OF A JOBLESS FUTURE (2015).

84. *See generally* THOMAS W. MILLER, MODELING TECHNIQUES IN PREDICTIVE ANALYTICS: BUSINESS PROBLEMS AND SOLUTIONS (2014). As an example, artificially intelligent machines can predict wine prices better than wine connoisseurs. *See Quants and Quaffs*, THE ECONOMIST (Aug. 8, 2015), http://www.economist.com/news/science-and-technology/21660405-artificial-intelligence-may-beat-connoisseurship-quants-and-quaffs [https://perma.cc/7PCL-X6U9]. Companies such as Amazon, Netflix, and Match.com have all used machine learning algorithms to better understand consumers' tastes. Pedro Domingos, *Why Businesses Embrace Machine Learning [Excerpt]*, SCI. AM. (Oct. 29, 2015), https://www.scientificamerican.com/article/why-businesses-embrace-machine-learning-excerpt/ [https://perma.cc/U5Y8-FNQG].

opportunities.[85] In the field of medicine, computers can analyze images and predict the likelihood of cancer.[86]

But today's use of big data and algorithms to predict outcomes is just the beginning. The capacity of computers to process information and collect and store data continues to explode.[87] The Director of Engineering at Google, Ray Kurzweil, recently noted: "There's a very smooth exponential increase in the price-performance of computing going back to the 1890 census."[88] As economist Professor William Nordhaus notes, the increase in computer power over the course of the twentieth century was "phenomenal," [89] improving manual computing power by a factor of between 1.7 trillion and 76 trillion times with an explosive trend beginning only after the Second World War.[90]

The growth in computational power has closely tracked "Moore's Law" over the past fifty years.[91] Moore's Law is the observation that the number of transistors in a dense integrated circuit doubles approximately every two years.[92] This observation has proved remarkably accurate and is now used as a guide to understanding where computing will be in the future.[93] If the trend continues, then within twenty years, computing power will be 1000 times what it is today.[94]

That trend will allow computing technology to expand its influence. In the same way that city planners have already developed computers that track aggregate traffic flows,[95] governments will likely be able to collect and use data on how humans

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85. Brad Power, *Artificial Intelligence Is Almost Ready for Business*, HARV. BUS. REV. (Mar. 19, 2015), https://hbr.org/2015/03/artificial-intelligence-is-almost-ready-for-business [https://perma.cc/ZA2K-57R3].

86. IBM's Watson, the same artificially intelligent process that defeated the grandmasters of *Jeopardy!*, has been used in the medical context. Carl Zimmer, *Enlisting a Computer To Battle Cancers, One by One*, N.Y. TIMES (Mar. 27, 2014), http://www.nytimes.com/2014/03/27/science/enlisting-a-computer-to-battle-cancers-one-by-one.html [https://perma.cc/89VR-LSYN].

87. *See* Martin Hilbert & Priscila Lopez, *The World's Technological Capacity To Store, Communicate, and Compute Information*, 332 SCIENCE 60 (2011) (estimating the growth of computing power and capacity); *see also Data, Data Everywhere,* ECONOMIST (Feb. 25, 2010), http://www.economist.com/node/15557443 [https://perma.cc/ZJZ2-8MHN].

88. *Ray Kurzweil on the Price-Performance of Computing*, WALL ST. J. ONLINE (Aug. 20, 2013, 1:29 AM), http://www.wsj.com/video/ray-kurzweil-on-the-price-performance-of-computing/C1F2B611-4B92-469C-AA33-3129587EC113.html [https://perma.cc/X8DZ-A9FL].

89. William D. Nordhaus, *Two Centuries of Productivity Growth in Computing*, 67 J. ECON. HIST. 128, 128 (2007).

90. *Id*. at 142–47.

91. *See* Lundstrom, *supra* note 28; Moore, *supra* note 28.

92. Lundstrom, *supra* note 28, at 210.

93. Indeed, some suggest that Moore's Law is akin to a self-fulfilling prophecy. *E.g.*, Harro van Lente & Arie Rip, *Expectations in Technological Developments: An Example of Prospective Structures To Be Filled in by Agency*, *in* GETTING NEW TECHNOLOGIES TOGETHER: STUDIES IN MAKING SOCIOTECHNICAL ORDER 206 (Cornelis Disco & Barend van der Meulen eds., 1998).

94. If this exponential trajectory continues to hold, by the end of this century, computing power will be over one trillion times what it is now.

95. *See, e.g.*, Todd Litman, *Generated Traffic: Implications for Transport Planning*, ITE J., Apr. 2001, at 38; *see also* Thomas Liebig, Nico Piatkowski, Christian Bockermann &

behave in almost all aspects of life. But the growth of data collection and analytics will not be uniform in all areas of law. The evolution will be fastest where regulated actors' behavior is more frequent and more homogenous. In these situations, lawmakers will have more data on how individuals behave. Where behavior is less frequent and more heterogeneous, the predictability of behavior will initially be weaker.

In the long run, however, artificially intelligent machines will not be bound by the limits currently facing big data.[96] Artificially intelligent machines are not simply programmed with a given structure to anticipate every possible contingency and every possible answer. Rather, artificially intelligent machines are trained to predict, infer, and intuit behavior and adapt to new and unique situations.[97]

Artificially intelligent machines find "hidden" or "deep" connections in unstructured data to provide stronger predictions.[98] In some sense, these machines are capable of "learning."[99] They update to take into account whether their best guesses are correct or not. In doing so, they amalgamate the wisdom of crowds.[100] Artificially intelligent machines marshal this wisdom better than traditional statistical techniques because the machines craft their own learning rules, rather than relying on a potentially biased structure imposed by humans.[101]

2. Predictive Technology Will Displace Human Discretion

In the near future, more perfect algorithms will begin to displace lawmaker

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Katharina Morik, *Dynamic Route Planning with Real-Time Traffic Predictions*, 64 INFO. SYS. 258 (2017).

96. *See, e.g.*, Daniela Rus, *The Robots Are Coming: How Technological Breakthroughs Will Transform Everyday Life*, FOREIGN AFF., July/Aug. 2015, at 2. *But see* Martin Wolf, *Same as It Ever Was: Why Techno-Optimists Are Wrong*, FOREIGN AFF., July/Aug. 2015, at 15 (providing a skeptical view).

97. *See generally* STUART RUSSELL & PETER NORVIG, ARTIFICIAL INTELLIGENCE: A MODERN APPROACH (3d ed. 2009).

98. *See, e.g.*, Geoffrey E. Hinton, Simon Osindero & Yee-Whye Teh, *A Fast Learning Algorithm for Deep Belief Nets*, 18 NEURAL COMPUTATION 1527 (2006).

99. Machine-learning algorithms learn by recognizing features, concepts, principles, and ideas that humans instinctively recognize but find difficult to program or code. Rather than having to structure a program in order to code rules, the rules are crafted and understood by the artificially intelligent machine.

100. *See* JAMES SUROWIECKI, THE WISDOM OF CROWDS: WHY THE MANY ARE SMARTER THAN THE FEW AND HOW COLLECTIVE WISDOM SHAPES BUSINESS, ECONOMIES, SOCIETIES AND NATIONS (2004).

101. Bias may affect algorithms that are based on traditional statistical techniques if some errors are not observable. If the bias is not corrected, errors can be replicated and reinforced by using the algorithm. But recently, a branch of artificial intelligence called *evolutionary computation* has been developed to deal with such problems. Evolutionary algorithms, based on techniques used by evolutionary biologists, use elements of trial and error to search for globally optimal solutions, rather than simply optimizing with the existing space. Candidate solutions are tested using an iterative process. *See* David B. Fogel, *Introduction to Evolutionary Computation*, *in* EVOLUTIONARY COMPUTATION 1: BASIC ALGORITHMS AND OPERATORS (Thomas Bäck, David B. Fogel & Zbigniew Michalewicz eds., 2000).

discretion. While this displacement of human discretion may appear novel in the legal sphere, it is simply a manifestation of the *Moneyball* phenomenon highlighted by Michael Lewis.[102]

In the book *Moneyball*, Lewis explores the use of data in major league baseball to elucidate the idea that statistics and data, used correctly, are superior to human judgment. Scouts and coaches in baseball previously relied on the "look" of the player to predict whether a player would make it in the big leagues.[103] But they were wrong. Their hunches were really just manifestations of years of inherited biases, prejudice, and outdated modes of thinking. Taking advantage of this, the Oakland A's used statistical analysis to consistently outperform rivals who had greater financial resources.[104]

The lesson here is that humans and their hunches are unreliable.[105] Examples can be found everywhere. From bankers assessing loan applicants[106] and employers hiring prospective employees[107] to commercial pilots flying planes,[108] humans increasingly place their trust in machines and discover that outcomes predicted by big data are systematically better than human intuition.

The phenomenon is starting to permeate the field of law. Consider how judges set bail. The decision to set bail has historically been based on a standard. The judge weighed a number of factors, such as the seriousness of the alleged crime, the likelihood of guilt, whether the defendant had jumped bail before, the defendant's social ties and employment situation, the defendant's mental condition, and so on.[109] The

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102. MICHAEL LEWIS, MONEYBALL: THE ART OF WINNING AN UNFAIR GAME (2003).

103. *Id.* at 32.

104. With limited financial resources, the A's were able to make the playoffs year after year by performing detailed statistical analyses of players to build a cost-effective, winning team that outperformed other teams with far higher payrolls. LEWIS, *supra* note 102.

105. *See* KAHNEMAN, *supra* note 20, at 4.

106. Bank managers who must decide whether or not to give a customer a loan have seen their discretion dissolve. Banks have turned to predetermined rules about who can borrow and how much they can borrow. The human bank manager is left with little discretion. The algorithm outperforms any individual bank manager in determining the viability of a customer.

107. Employers that use statistical analyses when hiring workers make better hiring decisions than humans that make hiring decisions based on a one-hour interview. *See, e.g.*, Chen-Fu Chien & Li-Fei Chen, *Data Mining to Improve Personnel Selection and Enhance Human Capital: A Case Study in High-Technology Industry*, 34 EXPERT SYS. WITH APPLICATIONS 280 (2008); Nathan R. Kuncel, David M. Klieger & Deniz S. Ones, *In Hiring, Algorithms Beat Instinct*, HARV. BUS. REV., May 2014, at 32.

108. Commercial airline pilots rely heavily on autopilot technology and are instructed not to take control of the airplane under certain circumstances. For example, the 2009 crash of Air France 447 into the Atlantic Ocean would have likely been prevented if the copilot did nothing and did not touch the controls when the plane encountered turbulence. BUREAU D'ENQUETES ET D'ANALYSES POUR LA SECURITE DE L'AVIATION CIVLE, FINAL REPORT ON THE ACCIDENT ON 1ST JUNE 2009 TO THE AIRBUS A330-203 REGISTERED F-GZCP OPERATED BY AIR FRANCE FLIGHT AF447 RIO DE JANEIRO–PARIS (2012), http://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf [https://perma.cc/WYZ3-PA6H].

109. See, for example, the standard in Massachusetts where bail is determined by examining the alleged crime, the likely penalty, the likely flight risk, history of defaults, family in the area, employment status, and previous criminal records, among other criteria. MASS

list of potentially relevant factors is almost inexhaustible.[110]

But now some jurisdictions are turning to predictive technology to reduce uncertainty and inconsistency in judges' decisions, as well as to reduce the time taken to set bail.[111] Algorithms have been developed that seek to predict when particular defendants will likely skip bail.[112] The predictive power of this algorithm, which takes into account data on the defendant's characteristics, far exceeds that of any individual judge.[113]

This output from the data is more systematic and reliable than an individual judge's hunch. The algorithm reduces error costs (it is better at assessing the likelihood of a defendant jumping bail) and decision costs (judges can simply apply the algorithm). Judges without the algorithm have less information and cannot process the information they do have as efficiently.

Moreover, judges introduce bias into the system by considering irrelevant factors. A well-meaning judge may not even know when she is considering irrelevant factors. A machine does not suffer from this problem. Relatedly, machines can be instructed to ignore factors that we do not want the law to consider. Thus a machine can be told to ignore race, gender, religion and the like even if they are relevant to an outcome objective. It is much harder for a judge to affirmatively ignore subconscious impacts of such factors.[114]

These observations run counter to the idea that there is something "special" and "human" about the law and legal reasoning.[115] Almost every profession thinks their profession is special.[116] In the same way that most drivers believe that they are above average,[117] humans reflexively believe that their judgment and reasoning is special

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GEN. LAWS ANN. ch. 276, § 57 (West 2015).

110. *Id.*

111. Shaila Dewan, *Judges Replacing Conjecture with Formula for Bail*, N.Y. TIMES (June 26, 2015), http://www.nytimes.com/2015/06/27/us/turning-the-granting-of-bail-into-a-science.html [https://perma.cc/B267-HDQR].

112. *Id.* Algorithms of this type are already in use in twenty-one jurisdictions across the United States, in places such as Arizona, Illinois, New Jersey, and Pennsylvania.

113. Recent work has illustrated the value of machine learning in reducing errors in granting bail. Crime can be reduced by up to 24.8% with no change in jailing rates, or jail populations can be reduced by 42.0% with no increase in crime rates. Jon Kleinberg, Himabindu Lakkaraju, Jure Leskovec, Jens Ludwig & Sendhil Mullainathan, *Human Decisions and Machine Predictions*, (Nat'l Bureau Econ. Res., Working Paper No. 23180, 2017), http://www.nber.org/papers/w23180.pdf [https://perma.cc/QRG3-ZY6W].

114. For machine algorithms, the instruction to ignore prohibited factors is not perfect. Other allowed variables may perfectly correlate with and therefore inadvertently proxy for out-of-bounds factors. These are sometimes called "clones." To the extent a lawmaker wants to exclude a factor from calculation, a programmer has to account for the correlation of clone variables.

115. *See* Joseph Raz, *Reasoning with Rules*, 54 CURRENT LEGAL PROBS. 1 (2001) (asking what is special about legal reasoning).

116. *See generally* MICHAEL A. BISHOP & J. D. TROUT, EPISTEMOLOGY AND THE PSYCHOLOGY OF HUMAN JUDGMENT 24–53 (2005) (humans instinctively deny or ignore the success of such technology because of deep-seated cognitive biases, such as overconfidence in our own abilities and judgments).

117. Iain A. McCormick, Frank H. Walkey & Dianne E. Green, *Comparative Perceptions*

and that technology cannot replicate or replace their particular skill. In *Moneyball*, baseball scouts thought that their ability to pick a future major league star would outperform any statistical analysis.[118] Doctors similarly think that doctors possess special skills.[119] The same is true of teachers.[120] Lawyers too.[121] Perhaps more surprisingly, legal scholars accustomed to looking for biases share this skewed we-are-special belief.

Legal philosophers often contend that law is *necessarily* vague and indeterminate.[122] Others argue that legal reasoning is different from other types of reasoning.[123] Professor Cass Sunstein, for example, suggests that legal reasoning requires an understanding of the principles that underpin reasoning by analogy and has been skeptical that artificial intelligence will be able to replicate this understanding.[124]

Professor Dan Kahan's 2006 address to the graduating class of Yale Law School provides a nice example of the argument that there is something "special" about law.[125] He contends that in order for lawyers to truly understand and evaluate legal reasoning they need years of learning from "grandmasters"[126]—such as professors and senior lawyers—who inculcate students with the power of legal intuition and judgment.[127]

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of Driver Ability—A Confirmation and Expansion, 18 ACCIDENT ANALYSIS & PREVENTION 205, 206 (1986) (about eighty percent of drivers believe that they are better than the median driver).

118. *See* LEWIS, *supra* note 102, at 29–42.

119. *See, e.g.*, DONALD E. POLKINGHORNE, PRACTICE AND THE HUMAN SCIENCES: THE CASE FOR A JUDGMENT-BASED PRACTICE OF CARE (2004); Samuel W. Bloom, *Structure and Ideology in Medical Education: An Analysis of Resistance to Change*, 29 J. HEALTH & SOC. BEHAV. 294 (1988).

120. *See* Françoise Blin & Morag Munro, *Why Hasn't Technology Disrupted Academics' Teaching Practices? Understanding Resistance to Change Through the Lens of Activity Theory*, 50 COMPUTERS & EDUC. 475 (2008).

121. *See* Jeffrey M. Lipshaw, *The Venn Diagram of Business Lawyering Judgments: Toward a Theory of Practical Metadisciplinarity*, 41 SETON HALL L. REV. 1 (2011).

122. *See, e.g.*, TIMOTHY A. O. ENDICOTT, VAGUENESS IN LAW 1 (2000) ("Although not all laws are vague, legal systems necessarily include vague laws.").

123. Lipshaw, *supra* note 121 (arguing that algorithmic judgment cannot replicate legal reasoning).

124. Cass R. Sunstein, *Of Artificial Intelligence and Legal Reasoning*, 8 U. CHI. LAW SCH. ROUNDTABLE 29, 32–34 (2001) (suggesting that computer programs do not reason analogically the way humans do); *see also* Brian Sheppard, *Incomplete Innovation and the Premature Disruption of Legal Services*, 2015 MICH. ST. L. REV. 1797, 1870 (suggesting that machines are limited in their abilities to understand complex law and cannot perform well and "would not play nice" where standards are currently the dominant form of law).

125. Dan M. Kahan, Deputy Dean and Elizabeth K. Dollard Professor of Law, Yale Law School Commencement Remarks (May 22, 2006), http://digitalcommons.law.yale.edu/cgi/viewcontent.cgi?article=1007&context=ylsca [https://perma.cc/C9ZA-QB4C].

126. *Id.*; *see also* Dan M. Kahan, David Hoffman, Danieli Evans, Neal Devins, Eugene Lucci & Katherine Cheng, *"Ideology" or "Situation Sense"? An Experimental Investigation of Motivated Reasoning and Professional Judgment*, 164 U. PA. L. REV. 349, 355 (2016) (testing whether judges have a unique "situation sense" expertise based on training and experience).

127. Kahan, *supra* note 125.

Professor Kahan compares the profession of lawyers to the profession of chick sexers who determine the gender of one-day old chicks. To the untrained eye, there is nothing discernibly different about newborn male and female chickens. And yet some people with training from a "chick-sexing grandmaster" can examine a chick and tell whether it is male or female with ninety-nine percent accuracy. Amazingly, no one (not even the chick sexers themselves) can say exactly what these experts are looking for. They simply know the difference when they see it. Professor Kahan claims that this "special power to intuitively perceive the gender of a newborn chick" is analogous to how lawyers determine the difference between "good and bad decisions."[128] Professor Kahan argues that lawyers learn how to reason in a special way, and that is what makes the craft of good lawyering so "distinctive" from other professions.[129]

Within four years of Professor Kahan's address, the world of chick sexing had changed dramatically. Predictive technology had been developed that could accurately determine the gender of a chick before birth.[130] Just as the machines defeated the grandmasters of chess and *Jeopardy!*, this new predictive technology bested the grandmasters of chick sexing.

Professor Kahan's address was not about the effect of technology on law. But the fate of chick sexers illustrates a major point: there is nothing so special about individual human intuition—at least in practice—that makes it immune to displacement by technology. Whether pure (unbiased and unrushed) human intuition is special and beyond replication is an unresolved philosophical question. But in application, human intuition is imperfect and biased. And machine technology can, it turns out, do as well as humans even when the individuals themselves cannot adequately describe their intuitive process.

The shortsighted belief that the legal profession is special and that lawyers and judges are immune from displacement by technological advances hinges on a bias that leads one to believe that only a human can deliver such wise judgments and decisions. Yes, lawyers require judgment. Yes, judges require judgment. But, the judgment of one human is outweighed by a decision generated by technology that takes into account millions of judgments and decisions.[131]

To see where this is all going for law, consider how artificially intelligent machines may turn one of the most classic statements of a standard in U.S. legal doctrine into a microdirective. In *Jacobellis v. Ohio*, Justice Potter Stewart found it very difficult to precisely pin down what distinguished pornography from nonpornography in determining the threshold test of obscenity.[132] Instead, he simply wrote: "I know it when I see it."[133]

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128. *Id.*

129. *Id.*

130. *Hey Little Hen*, THE ECONOMIST: ONLINE EXTRA (Feb. 9, 2010), http://www.economist.com/node/15491505 [https://perma.cc/8BLH-5P3W]. This new predictive technology relies on the detection of estrogen in the yolk of an egg. *Id.*

131. *See* SUROWIECKI, *supra* note 100. One might also note that judgment is about making the right decision in the absence of full information about outcomes. Once the outcomes are known, that sort of judgment is in a sense unnecessary.

132. Jacobellis v. Ohio, 378 U.S. 184, 197 (1964) (Stewart, J., concurring).

133. *Id.*

Justice Stewart's view suggests that distinguishing between pornography and nonpornography is something that humans can do, but it is difficult to write an ex ante rule that clearly defines the line. Justice Stewart preferred to leave the determination as a standard, to be resolved later.

Artificially intelligent technology can already recognize and analyze images.[134] It is not just a judge who can "see it." In the near future, artificially intelligent machines will be able to develop highly complex rules that generate immediate and simple predictions of the legality of particular materials ("this image is/is not pornographic"). Just imagine that Justice Stewart identified fifty pornographic images for the computer. At that point, the artificial intelligence programs can find deep connections to identify the pattern that is driving the distinction, but that Justice Stewart could not articulate. Indeed, such pattern recognition is one of the areas where this technology is already way ahead of humans. And it is why the technology is thought to be so valuable as a diagnostic tool.

If such technology were implemented, the law on the books might still look like a standard; but an individual could refer to the machine output to get advance microdirectives and behave as though she were governed by a rule.

B. The Feasibility of Communication Technology

Can lawmakers adequately give timely notice of the law to regulated actors? Can they provide these individuals with instant notice of how best to comply with the law? In the same way that traffic lights let a driver know that she should stop, communication technology can give rise to a world where all laws are reduced to stop-go directives that are instantly communicated to regulated actors. In this subsection, we discuss the types of technology and infrastructure that will facilitate this.

The costs of communication have been almost obliterated by the Internet. The so-called Internet of Things[135] is an interconnected network of physical objects and devices that are embedded with electronics and sensors to allow products to be controlled and used remotely by the user or manufacturer. Recent estimates suggest that between 50 billion to 100 billion objects and devices will be embedded with such technology by the year 2020.[136] Mobile applications are becoming the first port of

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134. Four Microsoft researchers have developed a visual recognition program that has an error rate of 4.94%, less than the 5.1% error rate of a human. Kaiming He, Xiangyu Zhang, Shaoqing Ren & Jian Sun, *Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification*, 2015 IEEE INT'L CONF. ON COMPUTER VISION 1026, http://www.cv-foundation.org/openaccess/content_iccv_2015/papers/He_Delving_Deep_into_ICCV_2015_paper.pdf [https://perma.cc/PC3A-87SQ]. According to one report, Japanese cameras are even being used to identify whether subway passengers are intoxicated. Amber Bouman, *Clever Cameras Detect Drunken Railway Passengers in Japan*, ENGADGET (Aug. 13, 2015), http://www.engadget.com/2015/08/13/clever-cameras-detect-drunken-railway-passengers-in-japan/ [https://perma.cc/RW3E-DVKQ].

135. Kevin Ashton, *That 'Internet of Things' Thing*, RFID J. (Jun. 22, 2009), http://www.rfidjournal.com/articles/view?4986 [https://perma.cc/46LY-7SCS].

136. Maria Farrell, *The Internet of Things—Who Wins, Who Loses?*, GUARDIAN (Aug. 14, 2015, 10:48 AM), http://www.theguardian.com/technology/2015/aug/14/internet-of-things-winners-and-losers-privacy-autonomy-capitalism [https://perma.cc/8T63-WR3F] (estimating 100

call for gathering and processing information.[137]

The Internet of Things and mobile applications are not, however, simply ways to improve the consumer experience. Lawmakers can use this technology. The Internet will facilitate *immediate* communication between lawmakers, regulators, individuals, and corporations. Take, for example, the field of environmental regulation. Regulators could more easily monitor emissions of factories through the Internet of Things. Regulators could instantly determine when factories are exceeding their limits and quickly inform firms operating those factories of the violation.

The example of advance tax rulings above suggests that the IRS will be able to provide immediate compliance information to individuals and corporations using similar technology to the Internet of Things. Regulated actors could enter information into a web-based or mobile application and receive a ruling on a device (like a phone) or some wearable technology (like a watch) from the regulator in a timely manner.

Such infrastructure already exists. For example, cardiologists today can simply refer to an app, enter in relevant information, and be given the optimal response for a patient.[138] As technology improves on the fact-gathering front, individuals may not even be required to enter much data into the programs; rather, devices will simply recognize the contours of the factual situation and give notice of whether the individual is complying with the law.

Indeed, lawmakers could even provide notice of microdirectives when the need for it is immediate. Individuals could wear items, such as contact lenses, that instantly analyze a situation and give an immediate directive as to the legality of a potential action. The military is already experimenting with this type of technology for identifying combat targets.[139] But more mundane uses are also probable: Can you turn left at an intersection? Can you cross the street? Can you attempt to board that subway car? And so on.

The Internet of Things drastically reduces the cost of a lawmaker communicating

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billion embedded objects); Philip N. Howard, *Sketching out the Internet of Things Trendline,* BROOKINGS: TECHTANK. (June 9, 2015), https://www.brookings.edu/blog/techtank/2015/06/09/sketching-out-the-internet-of-things-trendline/ [https://perma.cc/JZS6-ZVY8] (estimating 50 billion embedded objects).

137. For example, there are 2.2 million different applications at the Apple App store and 2.8 million Google Play applications. *See, e.g.*, *Number of Apps Available in Leading App Stores as of March 2017*, STATISTA, http://www.statista.com/statistics/276623/number-of-apps-available-in-leading-app-stores/ [https://perma.cc/QCL8-NUPW].

138. Winslow, *supra* note 40 (noting the availability of such an app launched by the American College of Cardiology in June 2015).

139. In an attempt to avoid (or, at least, minimize) friendly fire and fratricide, military scientists have developed combat identification technology (known as "Identification Friend or Foe" or "IFF") that can more easily and more quickly identify whether combatants are friendly or enemies. For example, Lockheed Martin recently announced certification to produce an IFF system for aircrews for the United States Department of Defense. *MEADS System Gains Full Certification for Identifying Friend or Foe Aircraft*, LOCKHEED MARTIN (May 21, 2014), http://www.lockheedmartin.com/us/news/press-releases/2014/may/mfc-052114-mead-system-gains-full-certification-identifying-friendfoe-aircraft.html [https://perma.cc/BU3H-6V3N].

with regulated actors. But the Internet of Things does not just facilitate communication. There is a feedback effect. The devices that form part of the Internet of Things also *collect* data on how individuals and corporations behave. Lawmakers can generate even better predictions of human behavior by harnessing such data.[140] In doing so, the Internet of Things will further reinforce the feasibility of the predictive technology.

III. IMPLICATIONS AND CONSEQUENCES

In this Part, we explore some implications and consequences of our predictions. If microdirectives become the dominant form of all law, these implications will be profound. But even a short-run trend in isolated fields of law will have major impacts on the way we think about law. We will focus on the long-run version of our prediction to demonstrate the scope of possible changes.

We suggest that the microdirectives will emerge as a new form of law that reduces the uncertainty costs of standards and the decision and error costs of rules. There are, however, other costs that may arise from a world of microdirectives. While the law will generate less uncertainty and fewer errors, it may be deficient in other ways. Here, we identify four areas where the consequences and potential costs of the emergence of microdirectives may be substantial. First, it will change the broad institutional balance of power in our political and legal system. Second, it may change the development and substantive content of legislative policy. Third, it will transform the practice and training of law. Fourth, it will have moral and ethical consequences for individual citizens, altering their day-to-day decision-making process and changing their relationship with lawmakers and government. In the remainder of this Part, we explore these implications and consequences in general terms. We conclude by noting how the existence of these costs may or may not affect our prediction.

A. The Death of Judging? Institutional Changes to the Legal System

The death of rules and standards will produce a shift in the balance of our political institutions. The proliferation of clear microdirectives largely obviates the need for ex post adjudication. This reduced role diminishes the ability of judges to influence the law and increases the power of ex ante lawmakers.[141] The change in the structure of the law does leave some room for some ex post adjudication of evidentiary questions, but even that will be reduced as the technology for observing facts ex ante improves.

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140. *Cf.* Porat & Strahilevitz, *supra* note 12 (discussing fact-gathering technology for personalized default rules).

141. *See* Ehrlich & Posner, *supra* note 2, at 261 ("The legislature's choice whether to enact a standard or a set of precise rules is implicitly also a choice between legislative and judicial rulemaking."); *see also* Schauer, *supra* note 3, at 310 ("According to the conventional wisdom, therefore, the choice between rules and standards . . . is an important and powerful implement of institutional design, determining much of who decides what in a complex and multi-institutional society."). In this sense, the death of rules and standards precedes the death of the judicial function.

This is potentially concerning because when judges decide cases they do more than simply apply rules or standards. They also have the ability to shift and modify the law. This can happen in at least three different ways. First, judges can interpret a law (rule or standard) differently than the ex ante lawmakers intended—assuming those lawmakers even had an identifiable intent.[142] Judges can also choose to ignore rules and standards altogether in the guise of interpretation.[143]

Second, judges can influence popular and institutional views about policy objectives. Judges can impact popular opinion by highlighting a particular issue in a case, using their position to make policy statements, or by issuing incremental holdings that generate support for movements that have broader consequences.[144] Additionally, given the U.S. federal system, decisions of courts in one jurisdiction might have larger social consequences that impact nonjudicial change to policy objectives in other jurisdictions.[145] Many think that this role of the courts in challenging stale and

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142. On the ability of judges to add their own interpretation, see—among many others—STANLEY FISH, IS THERE A TEXT IN THIS CLASS? (1980); Robert W. Bennett, *Objectivity in Constitutional Law*, 132 U. PA. L. REV. 445 (1984); Anthony D'Amato, *Can Legislatures Constrain Judicial Interpretation of Statutes?*, 75 VA. L. REV. 561 (1989); Michael S. Moore, *The Semantics of Judging*, 54 S. CAL. L. REV. 151, 251–52 (1981); Frederick Schauer, *An Essay on Constitutional Language*, 29 U.C.L.A. L. REV. 797 (1982). *But see* William N. Eskridge, Jr., *Overriding Supreme Court Statutory Interpretation Decisions*, 101 YALE L.J. 331 (1991). The idea that legislative intent exists is not obvious. *See, e.g.*, Kenneth A. Shepsle, *Congress Is a "They," Not an "It": Legislative Intent as Oxymoron*, 12 INT'L REV. L. & ECON. 239 (1992).

143. *See, e.g.*, Anthony Niblett & Albert H. Yoon, *Friendly Precedent*, 57 WM. & MARY L. REV. 1789, 1795 (2016) (finding that Court of Appeals judges lean towards citing precedents that align with the political composition of the panel); Anthony Niblett & Albert H. Yoon, *Judicial Disharmony: A Study of Dissent*, 42 INT'L REV. OF L. & ECON. 60, 64–67 (2015) (showing that different judges writing different opinions in the same case cite different precedents and lean toward precedents that align with each judge's political preference); William Hubbard & M. Todd Henderson, *Do Judges Follow the Law? An Empirical Test of Congressional Control Over Judicial Behavior* (Coase-Sandor Inst. L. & Econ., Working Paper No. 671, 2014). *But see* Anthony Niblett, *Do Judges Cherry Pick Precedents to Justify Extra-Legal Decisions?: A Statistical Examination*, 70 MD. L. REV. 234 (2010).

144. The legitimation hypothesis suggests that public opinion will begin to converge toward the opinion of the court after a court has handed down a decision. *See, e.g.*, Brandon L. Bartels & Diana C. Mutz, *Explaining Processes of Institutional Opinion Leadership*, 71 J. POL. 249 (2009); Valerie Hoekstra, *The Supreme Court and Opinion Change: An Experimental Study of the Court's Ability To Change Opinion*, 23 AM. POL. Q. 109 (1995). There is prominent literature discussing "backlash" to court decisions that have the opposite effect of the legitimation hypothesis. *See, e.g.*, Michael J. Klarman, *How* Brown *Changed Race Relations: The Backlash Thesis*, 81 J. AM. HIST. 81 (1994). Others suggest that the effect is more constrained. *See, e.g.*, GERALD N. ROSENBERG, THE HOLLOW HOPE: CAN COURTS BRING ABOUT SOCIAL CHANGE? (1991). Further, court decisions can polarize opinion. *See* Charles H. Franklin, & Liane C. Kosaki, *Republican Schoolmaster: The U.S. Supreme Court, Public Opinion, and Abortion*, 83 AM. POL. SCI. REV. 751 (1989); Timothy R. Johnson & Andrew D. Martin, *The Public's Conditional Response to Supreme Court Decisions*, 92 AM. POL. SCI. REV. 299 (1998).

145. For example, in 2003, the Massachusetts Supreme Judicial Court held that same-sex marriage was legal. Goodridge v. Dep't of Pub. Health, 798 N.E.2d 941 (Mass. 2003). Scholars

entrenched views has a salutary effect on our democracy.[146]

Finally, judges can outright declare policy objectives to be improper or unconstitutional.[147] This judicial review of legislative policy is considered by many to be an integral part of our system of checks and balances.[148]

These lawmaking roles of judges will change along with the fundamental nature of law. Judges will lose much of their oversight and lawmaking power. For nonconstitutional questions, the interpretive role may disappear entirely.[149] They will no longer have the power to reinterpret or ignore laws. The policy objectives of law will be set by the ex ante rule makers (legislative or regulatory). And the judiciary—at least if it maintains its current form and structure—will have little or no occasion to question or change those policy objectives. The opportunities for statutory interpretation and filling in the gaps in vague standards will dry up as citizens are simply instructed to obey simple directives.

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have debated the effect that this decision had on public opinion and whether the subsequent change in public opinion set the law on a new path, culminating in the Supreme Court of the United States finding a constitutional right to same-sex marriage in 2015. *See* MICHAEL J. KLARMAN, FROM THE CLOSET TO THE ALTAR: COURTS, BACKLASH, AND THE STRUGGLE FOR SAME-SEX MARRIAGE 89–118 (2013); Patrick J. Egan, Nathaniel Persily & Kevin Wallsten, *Gay Rights*, *in* PUBLIC OPINION AND CONSTITUTIONAL CONTROVERSY 234, 239–245 (Nathaniel Persily, Jack Citrin & Patrick J. Egan eds., 2008); Thomas M. Keck, *Beyond Backlash: Assessing the Impact of Judicial Decisions on LGBT Rights*, 43 LAW & SOC'Y REV. 151 (2009); Jane S. Schacter, *Courts and the Politics of Backlash: Marriage Equality Litigation, Then and Now*, 82 S. CAL. L. REV. 1153 (2009).

146. *See generally* ALEXANDER M. BICKEL, THE LEAST DANGEROUS BRANCH (Yale Univ. Press 2d ed. 1986) (1962); Robert A. Dahl, *Decision-Making in a Democracy: The Supreme Court as a National Policy-Maker*, 6 J. PUB. L. 279 (1957).

147. Marbury v. Madison, 5 U.S. (1 Cranch) 137 (1803); *see also* Saikrishna B. Prakash & John C. Yoo, *The Origins of Judicial Review*, 70 U. CHI. L. REV. 887, 887 (2003) ("In [*Marbury v. Madison*], as it is often taught in law schools, the Supreme Court created its authority to declare federal statutes unconstitutional.").

148. *See* JOHN HART ELY, DEMOCRACY AND DISTRUST: A THEORY OF JUDICIAL REVIEW (1980); Barry Friedman, *The Importance of Being Positive: The Nature and Function of Judicial Review*, 72 U. CIN. L. REV. 1257 (2004) (discussing the role that judicial review plays in our legal system); David A. Strauss, *The Modernizing Mission of Judicial Review*, 76 U. CHI. L. REV. 859 (2009) (explaining the role of judicial review in democratic government). There are, of course, strong critics of judicial review. *See, e.g.*, Larry D. Kramer, *Putting the Politics Back into the Political Safeguards of Federalism*, 100 COLUM. L. REV. 215, 233–37 (2000); Larry D. Kramer, *The Supreme Court 2000 Term—Foreword: We the Court,* 115 HARV. L. REV. 5 (2001) (critiquing modern conceptions of judicial review and judicial supremacy); William W. Van Alstyne, *A Critical Guide to* Marbury v. Madison, 1969 DUKE L. J. 1, 38–45 (collecting sources on the question of the legitimacy of judicial review).

149. Deciding nonconstitutional questions is the bulk of what judges do. Constitutional questions, while high profile, reflect a small fraction of the judicial caseload. Even in the Supreme Court of the United States, the percentage of cases has not exceeded fifty percent in recent years. *See* RICHARD A. POSNER, HOW JUDGES THINK 271 (2008). The number is far lower in state courts. *See, e.g.*, Robert A. Kagan, *Constitutional Litigation in the United States*, *in* CONSTITUTIONAL COURTS IN COMPARISON 25, 28 (Ralf Rogowski & Thomas Gawron eds., 2002) (noting that over the period 1940–1970, only 14.6% of state court cases had constitutional issues).

The concern here is a separate question than whether machine-aided algorithms can implement policy objectives. The question is whether there is an independent branch of government with the power to question the policy decisions of the ex ante lawmakers. When the lawmakers decide on legislative objectives and parameters for the machine algorithms, do we want a separate branch of government to review those decisions? If we do, the reduced role of the judiciary is troubling.

Moreover, the number of cases litigated will plummet. The question in most cases will simply be whether or not the citizen complied with the simple directive. The case will have two questions: Was the light red? And did the citizen stop? The evidence to answer those questions will continue to be more readily accessible. As the number of cases and controversies litigated falls and the interpretation of policy becomes unnecessary, a judge's opportunities to use a case to make policy statements and impact opinion will diminish. On the other hand, the judge's opportunities to inject bias and error will also diminish.[150]

Things are a little more complicated for questions of constitutional law. In theory at least, constitutional standards[151] are no different from the standards we have discussed throughout this Article. A machine could easily be programmed to tell us whether a particular search was unreasonable,[152] whether certain speech was pornography, whether microdirectives are valid under the commerce clause or some other provision, and so on.

There are institutional structures, however, that may appear to be barriers to the promulgation of microdirectives for constitutional review. As our regime currently stands, neither Congress nor any agency can dictate that a machine algorithm will decide the constitutionality of laws. If Congress creates an algorithm that takes into account race or results in the prohibition of speech, the courts—and not a machine—would declare those algorithms unconstitutional.

As long as *Marbury v. Madison*[153] remains good law, the constitutional decision on an algorithm would have to come from the judiciary. But the courts could, of course, bless the use of particular types of algorithms going forward, deeming these to be constitutionally proper. For example, an exigent search that was conducted pursuant to a machine directive could be presumed to be reasonable if the machine used a judicially blessed algorithm. This precedential guidance to regulatory agencies[154] could essentially provide the policy objectives that must guide the microdirective technology for constitutional review. This delegation would facilitate the promulgation of microdirectives in the constitutional law space.

Some, of course, may argue that reducing judicial power over policy is a good thing. As the democratically elected branches become more powerful, for example, fears about overreaching by unelected judges will be dampened.[155] Others will

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150. *See supra* Part II.

151. The U.S. Constitution generally operates through standards. Schauer, *supra* note 3, at 308.

152. *Cf.* Michael L. Rich, *Machine Learning, Automated Suspicion Algorithms, and the Fourth Amendment*, 164 U. PA. L. REV. 871 (2016).

153. 5 U.S. (1 Cranch) 137 (1803).

154. We discuss this type of second-order regulation above. *See supra* Part I.C.1.

155. *See, e.g.*, LARRY D. KRAMER, THE PEOPLE THEMSELVES: POPULAR CONSTITUTIONALISM AND JUDICIAL REVIEW (2004); *see also* sources cited *supra* note 148.

disagree.[156] For those who advocate the active role of judges, alternative mechanisms for that role might be pursued. Perhaps a judiciary that provides advisory opinions on legislative and regulatory policy decisions could preserve the judiciary's oversight and influence on society.[157]

B. The Development and Substance of Policy Objectives

In addition to policy decisions moving away from judges, the process by which legislatures and regulators make those decisions will change.

Broader objectives. As we noted above in Part I.D., regulatory agents will be the primary force behind the shift to microdirectives. Legislatures may continue to enact standards, but they will leave the machine-aided implementation to regulators. Those standards may be nothing more than a statement of the policy objective that should guide the rule-making machines. Regulators will then translate that broad objective into specific sets of rules generated by machines.[158]

Additionally, the ability to achieve broad goals through machine-derived microdirectives will potentially allow legislatures to state their objectives at increasingly higher levels of abstract social policy. Rather than concern themselves with details of implementation, the legislature will be able to concentrate on the bigger picture. For example, instead of worrying about specific speed limits, the legislature will focus on the purpose of traffic law: does society want laws that reduce accidents, minimize travel time, reduce fuel consumption, or some perfect mix?

At its extreme, learning algorithms aided by big data could be asked to prescribe a vast set of microdirectives covering multiple fields to achieve an even broader social goal, such as maximizing welfare, minimizing accidental death, minimizing wealth inequality, or (more likely) some combination that sets certain acceptable thresholds for these and other social values. This becomes possible because lawmakers no longer have to figure out and set out each precise rule and its connection to other rules. Instead, machines will work out the millions of connected microdirectives that achieve a stated slate of policy objectives. This complex catalog of microdirectives can be targeted to small instances of behavior that fit within a larger web of behavioral actions to achieve a broad goal.

Faster change. Algorithm-driven laws will automatically and rapidly adapt to the circumstances, optimizing according to the objective of the law. But changes to the law result in winners and losers.[159] Frequent changes to the law may impose additional risks on individuals and may affect the willingness of individuals to invest in

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156. *See* sources cited *supra* note 148.

157. On the other hand, it is possible that the influence on society requires actual cases and controversies to make judicial rulings more salient.

158. *See* Benjamin Alarie, Anthony Niblett & Albert H. Yoon, *Regulation by Machine*, 18 J. MACHINE LEARNING & RES. (forthcoming 2017).

159. *See, e.g.*, MICHAEL J. TREBILCOCK, DEALING WITH LOSERS: THE POLITICAL ECONOMY OF POLICY TRANSITIONS 1–3 (2014) (discussing how changes in legal policy that are not compensating reduces the incentive to make optimal investments); Louis Kaplow, *An Economic Analysis of Legal Transitions*, 99 HARV. L. REV. 509 (1986) (providing an economic analysis of the gains and losses created by legal transitions); Louis Kaplow, *Government Relief for Risk Associated with Government Action*, 94 SCANDINAVIAN J. ECON. 525 (1992) (exploring and

projects that may be subject to legal uncertainty.[160] A smart machine will, however, be able to take into account any effects on the values of reliance investments to find a global optimum, rather than merely a local optimum.

Moreover, predictive technology can be used to advise lawmakers on other potential unintended consequences of certain policy objectives. Under today's system, laws frequently have unintended consequences. Laws that change behavior in unexpected ways that undermine the law's goal or disrupt some unrelated area of human behavior in unexpected ways are common.[161]

With the current state of technology, it often takes years before the consequences of a policy decision are fully understood. But as big data and predictive technology improve, lawmakers will be able to more accurately identify these consequences at the time when they make the rules.[162]

Unintended consequences. The potential for unintended consequences highlights an important facet of the death of rules and standards. Those who set the broad policies in this new world will need to have deep understandings of both social objectives and the way that these technologies work. Machine-generated microdirectives can only reduce unintended consequences if the machines are programmed to identify the types of consequences about which policymakers or society care. The humans who instruct machines to create microdirectives must communicate policy objectives to the machines in ways that do not distort the message, and they must "ask" the machines to provide assessments of the consequences of proposed objectives.

If lawmakers do not have a deep understanding of policy consequences and programming, the machines may distort rather than further law.[163] Such concerns animate many science-fiction movies about the fears of artificial intelligence.[164] The

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modeling the costs imposed by government transitions).

160. The fact that such uncertainty leads to a reduced ex ante investment is a manifestation of the hold-up problem. *See generally* Paul A. Grout, *Investment and Wages in the Absence of Binding Contracts: A Nash Bargaining Approach*, 52 ECONOMETRICA 449 (1984); Oliver Hart & John Moore, *Foundations of Incomplete Contracts,* 66 REV. ECON. STUD. 115 (1999); Jean Tirole, *Procurement and Renegotiation*, 94 J. POL. ECON. 235 (1986).

161. *See generally* Robert K. Merton, *The Unanticipated Consequences of Purposive Social Action*, 1 AM. SOC. REV. 894 (1936). An example of a recent legislative change with unintended consequences occurred when the Ontario government increased access to the small claims court, which had a regressive effect, with richer plaintiffs displacing poor plaintiffs. *See* Anthony Niblett & Albert H. Yoon, *Unintended Consequences: The Regressive Effects of Increased Access to Courts*, 14 J. EMPIRICAL LEGAL STUD. 5 (2017).

162. The technology may, however, get ahead of itself. While predictive technology reduces the chance of unintended consequences for any given law, it also increases the rate at which laws can be promulgated. If the rate of promulgation increases fast enough, unintended consequences may increase even as laws become more accurate. We must know more about how eager lawmakers will be to promulgate microdirectives to understand how significant this risk is.

163. In the literature on artificial intelligence, this is referred to as "perverse instantiation." *See, e.g.*, NICK BOSTROM, SUPERINTELLIGENCE: PATHS, DANGERS, STRATEGIES, 146–49 (2014).

164. Such dystopian visions of the future are found in many popular books and movies. *See, e.g.*, ISAAC ASIMOV, I, ROBOT (1950); 2001: A SPACE ODYSSEY (Metro-Goldwyn-Mayer 1968); ROBOCOP (Orion Pictures 1987); TERMINATOR 2: JUDGMENT DAY (Carolco Pictures 1991). *See generally* Illah Reza Nourbakhsh, *The Coming Robot Dystopia: All Too Inhuman,*

current debate about Google driverless cars highlights these concerns. Many have questioned how one should program a self-driving car to deal with ethical decisions about the value of life.[165] Can Google cars, they ask, deal with ethical questions that face human drivers? One commentator notes that humans believe that avoiding a collision with a dog is more important than avoiding a collision with animals that are not pets (like squirrels).[166] But machines—if programmed correctly—could replicate that value judgment and, given the advances in predictive technology, would execute the judgment with greater accuracy than a human. On the other hand, if the commentator is wrong—and squirrels are to be avoided with the same care as dogs—then the program can be changed accordingly.[167] The key, then, is in the lawmaker's ability to program that value into the machines.

Still, some appear to worry that poorly programmed cars will implement a frightening system of social values where they swerve to kill the "wrong" people.[168] Implicit in this critique, however, is the false idea that *human* drivers always swerve to kill the "right" people. It would seem that the trick in getting all of this right is not in programming the computer, but in somehow agreeing on which people are the "right" ones to kill. That is an age-old moral problem to which we still do not have an agreed-upon answer. Thus, the so-called "trolley problem"[169] is, indeed, a real one for self-driving cars. But that is a familiar critique on the limits of *human* ethics, not on the limits of self-driving cars. In other words, it is still a problem for human-driven cars too.

FOREIGN AFF., July–Aug. 2015, at 23.

165. *See, e.g.*, Chris Bryant, *Driverless Cars Must Learn To Take Ethical Route*, FIN. TIMES (Mar. 1, 2015), http://www.ft.com/intl/cms/s/0/4ab2cc1e-b752-11e4-981d-00144feab7de [https://perma.cc/D6V9-BEFS]; Patrick Lin, *The Ethics of Autonomous Cars*, ATLANTIC (Oct. 8, 2013), http://www.theatlantic.com/technology/archive/2013/10/the-ethics-of-autonomous-cars/280360/ [https://perma.cc/QQ7V-D4C3].

166. *A Point of View: The Ethics of the Driverless Car*, BBC: MAG. (Jan. 24, 2014), www.bbc.com/news/magazine-25861214 [https://perma.cc/A847-2JRJ].

167. Janet D. Stemwedel, *Building Self-Driving Cars That Drive Ethically*, FORBES (Aug. 5, 2015, 4:45 PM), http://www.forbes.com/sites/janetstemwedel/2015/08/05/building-self-driving-cars-that-drive-ethically/ [https://perma.cc/2QRH-3U5B] (noting that Google is consulting with moral philosophers).

168. *See* Tanay Jaipuria, *Self-Driving Cars and the Trolley Problem*, HUFFINGTON POST: BLOG (June 1, 2015, 12:13 PM), http://www.huffingtonpost.com/tanay-jaipuria/self-driving-cars-and-the-trolley-problem_b_7472560.html [https://perma.cc/CP4M-5GC4] (asking whether cars can make ethical decisions that must value different lives and whether they should favor the life of their owner); Tim Worstall, *When Should Your Driverless Car from Google Be Allowed To Kill You?*, FORBES (June 18, 2014, 8:27 AM), http://www.forbes.com/sites/timworstall/2014/06/18/when-should-your-driverless-car-from-google-be-allowed-to-kill-you/ [https://perma.cc/ZL3N-4A9H] (same).

169. The trolley problem can take different forms but usually presents the question of what one would do if a trolley is on track to kill a group of people and the observer can pull a lever that will divert the trolley to a different course that will kill one (different) person, thus saving the group. On the trolley problem, see generally, PHILIPPA FOOT, *The Problem of Abortion and the Doctrine of the Double Effect*, *in* VIRTUES AND VICES AND OTHER ESSAYS IN MORAL PHILOSOPHY (1978); Judith Jarvis Thomson, Comment, *The Trolley Problem*, 94 YALE L.J. 1395 (1985).

In any event, lawmakers of the future must be able to translate society's values into programmable objectives for the machines. The task of identifying those values, it seems to us, will remain a human one.[170]

C. Changes to the Practice of Law

The observations thus far lead naturally to the next related observation: the death of rules and standards will fundamentally transform the practice of law. For years, a chorus of scholars have been pointing out that technology will disrupt and transform the practice of law.[171] We join this chorus to note that as lawmakers adopt laws that are translated and communicated to citizens as simple microdirectives, the role of lawyers will change dramatically. The role of compliance and litigation lawyers will diminish, while the role of a lawyer as lobbyist or policy advisor will grow.

The compliance lawyer today serves as an intermediary who advises a client on how best to comply with complex rules or vague standards. Part of the expertise of a compliance lawyer is in predicting how an ex post adjudicator will likely apply the relevant standard to a certain set of facts.

Thus, in our tax example, a client might ask a lawyer whether or not her business arrangement complies with the standards of the tax code. In our medical example, a doctor might ask a lawyer whether her diagnostic procedures would be deemed reasonable under the controlling legal standard. The lawyer reads the relevant law and exercises her judgment—based on education, experience, and other expertise—to provide a prediction. The lawyer may go beyond a yes or no answer and suggest creative ways that a client could alter behavior to increase the likelihood that the adjudicator would find the client in compliance.

Technology will reduce the need for such compliance lawyers. The citizen will simply be told directly whether behavior complies with the law or not. There is no need to consult a lawyer to ask whether a traffic light is green or red. Similarly, litigators will no longer be in the business of arguing about the application of standards, and judges will no longer be in the business of applying them.

There will be skeptics. As discussed above in Part II, even though technology has already displaced many labor markets, there is a common sentiment that many hold that *their* profession is different and somehow immune to technological disruptions.[172] But simply noting that a compliance lawyer's role as information middleman will disappear is not to say that the entire profession of law will be automated. Rather, there will be a shift in the types of tasks that lawyers are charged with. Lawyers will be forced to adapt to the new environment.

Setting the policy directives of a machine algorithm is complicated. To tell a machine that its objective is to minimize traffic accidents, without more, would lead to

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170. There is a possibility that machines could simply observe human behavior and from that deduce what objectives the majority of persons would do and follow that behavior. That would eliminate even the need for human policy considerations. We reject that possibility—not because the computers cannot do it, but because few would agree that entrenching observed majoritarian behavior is the appropriate objective of law.

171. *E.g.*, SUSSKIND, TOMORROW'S LAWYERS, *supra* note 11; Henderson, *supra* note 11; Katz, *supra* note 11; Ribstein, *supra* note 11.

172. *See supra* Part II.A.2.

standstill traffic—or, more absurdly, the prohibition of motor vehicles. Instructing the machine to minimize travel times could lead to an abundance of car accidents. A machine can only write rules to meet the objective as it is presented. As we have discussed, the humans who set the objective must be able to understand the consequences of different objectives and must be able to understand which objectives are desirable.

Understanding the implications of different objectives requires not only an understanding of the technology, but also a highly interdisciplinary understanding of human behavior and the goals of our regulatory state. The trend of the last fifty years toward interdisciplinary legal education,[173] with an emphasis on understanding topics such as economics, psychology, philosophy, history, and so on, is one that will serve this new role of lawyers well. We note in passing that recent countertrends toward so-called practical lawyering[174] are likely to be wasteful. The idea of training lawyers solely in practical skills provides little benefit when the skills required are likely to change rapidly. The understanding of legal policy should remain the focus of the legal endeavor because human individuals will set the high-level policy objectives for the law.[175]

D. The Broader Consequences of These Technologies on Individuals

The death of rules and standards will raise major concerns about privacy, autonomy, and the ethics of human decision making.

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173. *See generally* ROBIN L. WEST, TEACHING LAW: JUSTICE, POLITICS, AND THE DEMANDS OF PROFESSIONALISM (2014); Harry T. Edwards, *The Growing Disjunction Between Legal Education and the Legal Profession*, 91 MICH. L. REV 34, 34–35 (1992) (documenting the rise of "law and" movements being taught at law schools); Alex M. Johnson, Jr., *Think Like a Lawyer, Work Like a Machine: The Dissonance Between Law School and Law Practice*, 64 S. CAL. L. REV. 1231 (1991); Anthony D'Amato, *The Interdisciplinary Turn in Legal Education* (Nw. Pub. L. & Legal Theory, Research Paper No. 06-32, 2006), https://ssrn.com/abstract=952483 [https://perma.cc/C54C-2XVM].

174. *See* WILLIAM M. SULLIVAN, ANNE COLBY, JUDITH WELCH WEGNER, LLOYD BOND & LEE S. SHULMAN, EDUCATING LAWYERS: PREPARATION FOR THE PROFESSION OF LAW 12 (2007); R. Michael Cassidy, *Beyond Practical Skills: Nine Steps for Improving Legal Education Now*, 53 B.C. L. REV. 1515 (2012); Joe Palazzolo, *Law-School Program Emphasizes Practical Skills*, WALL ST. J. (Jan. 4, 2015, 7:51 PM), http://www.wsj.com/articles/law-school-program-emphasizes-practical-skills-1420419113 [https://perma.cc/Y6X6-B2HU].

175. To be clear, this is not a technological limitation. Policy will be set by humans rather than machines because that is the one area where humans will resist technological advances most strongly. There are, of course, many who think all aspects of life will inevitably be controlled by artificial intelligence. *See, e.g.*, Ray Kurzweil, THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY (2005). Others are skeptical. *See, e.g.*, Peter Murray, *Leading Neuroscientist Says Kurzweil Singularity Prediction a "Bunch of Hot Air"*, SINGULARITY HUB (Mar. 10, 2013), https://singularityhub.com/2013/03/10/leading-neuroscientist-says-kurzweil-singularity-prediction-a-bunch-of-hot-air/ [https://perma.cc/M68W-HX9V]. In any case, the power over ultimate policy objectives will be one of the last things that humans cede to machines.

1. Privacy

Most obviously, as with all applications of big data, the use of data gathering to predict outcomes raises privacy concerns.[176] These concerns have been addressed extensively in other contexts.[177] In our context, the potential for invasions of privacy is high. Government-controlled machines will be gathering data about individual behavior and using that information in two ways. First, they will use the information to assess an individual's behavior and provide a legal directive. Second, they will use the information as part of its aggregated data that goes into setting the microdirectives. Stoplight cameras and GPS tracking already create the ability for the government to know a citizen's comings and goings. These capabilities to invade privacy will increase. And the concerns become greater when the government uses the information it gathers in conjunction with technology to predict future actions by an individual.[178]

There is a trade-off here. The more limitations placed on the government's ability to gather information, the weaker will be its ability to create precise microdirectives.[179] Moreover, there may be privacy-based calls for the halting of microdirectives because the mere prediction based on aggregate data violates principles of privacy.

The debate and policy choices on privacy here are likely to track general debates and choices about privacy and big data. One can also expect that as individuals continue to waive privacy in private-law contexts,[180] public law will be given additional freedom to gather information that facilitates the evolution of microdirectives.

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176. *See, e.g.*, Farrell, *supra* note 136 (investigating the effect of the Internet of Things on privacy and autonomy, suggesting that they will become the preserve of the powerful).

177. The literature on this new topic is already vast. *See* PRIVACY, BIG DATA, AND THE PUBLIC GOOD (Julia Lane, Victoria Stodden, Stefan Bender & Helen Nissenbaum eds., 2014); Lisa Austin, *Privacy and the Question of Technology*, 22 LAW & PHIL. 119 (2003); Paul Ohm, *Broken Promises of Privacy: Responding to the Surprising Failure of Anonymization*, 57 UCLA L. REV. 1701 (2010); Paul Ohm, *Sensitive Information*, 88 S. CAL. L. REV. 1125 (2015); Paul Ohm, Response, *The Underwhelming Benefits of Big Data,* 161 U. PA. L. REV. ONLINE 339 (2013); Porat & Strahilevitz, *supra* note 12, at 1467–68; Richard A. Posner, *Privacy, Surveillance, and Law*, 75 U. CHI. L. REV. 245 (2008); Paul M. Schwartz, *Information Privacy in the Cloud*, 161 U. PA. L. REV. 1623 (2013); Daniel J. Solove, *Data Mining and the Security-Liberty Debate*, 75 U. CHI. L. REV. 343 (2008); Omer Tene & Jules Polonetsky, *Big Data for All: Privacy and User Control in the Age of Analytics*, 11 NW. J. TECH & INTELL. PROP. 239 (2013); Omer Tene & Jules Polonetsky, *Privacy in the Age of Big Data: A Time for Big Decisions*, 64 STAN. L. REV. ONLINE 63 (2012).

178. The U.S. government has started to investigate the benefits and costs of using big data. *See* EXEC. OFFICE OF THE PRESIDENT, BIG DATA: SEIZING OPPORTUNITIES, PRESERVING VALUES (2014).

179. *Cf.* Porat & Strahilevitz, *supra* note 12, at 1467–68 (noting the trade-off between privacy protections and "granular personalized default rules"). As predictive technology gets better, less and less personal data will be necessary to create precise microrules. But some information gathering will always be necessary.

180. S*ee id.* at 1468 (noting that "most consumers bring strongly pragmatic perspectives to privacy tradeoffs, and they are increasingly willing to share information about themselves when the benefits from sharing are increased and the threats from sharing are diminished").

2. Autonomy

As lawmakers promulgate more precise microdirectives to advance broad policy objectives, the scope of law can expand. Take, for example, a broad policy objective that seeks to increase productivity. In the hands of a powerful algorithm, microdirectives aimed at a broad goal like that could dictate virtually every decision in a citizen's life. Smart traffic lights could decide who goes first based on productivity levels. Smart restaurants could dictate what a citizen is allowed to eat for breakfast.[181] This presents real concerns for individual autonomy.[182]

But these concerns are not direct objections to the use of predictive technology. Rather they are objections to reckless lawmaking or to overreaching. Lawmakers have to understand what objectives to use in setting microdirectives. Improving productivity might be one policy objective, but there may be other constraining objectives that should be factored in, such as respecting certain spheres of individual decision making. If principles of human autonomy require the law to allow humans to make certain decisions even when those decisions are inconsistent with other social values, then the lawmakers must be aware of those principles and avoid encroaching on them when they set policy objectives. This reinforces the importance of lawyers and lawmakers as interdisciplinary policy experts.

The well-trained expert lawmaker might still overreach. The technologies we have described provide the tools for almost limitless lawmaking. A goal to increase productivity at all costs is difficult to enact through legislation today—the information costs are too high. But that will not be the case with microdirectives. As the information limits on lawmaking fall, it will only be political costs that restrain those in power. As in our discussion of the diminished role of judges, this once again counsels in favor of attention to institutional structures.

A final and perhaps even deeper concern is that lawmakers may turn the microdirectives into *actual* physical restraints on action. Rather than tell you that the light is red, the technology of the future may simply prevent your car from moving. A self-driving car with no driver override could be entirely in the control of the lawmaker.[183]

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181. There is no doubt that such outcomes would be controversial, as the debate over the "broccoli" analogy in the Affordable Care Act litigation demonstrated. *See* James B. Stewart, *How Broccoli Landed on Supreme Court Menu*, N.Y. TIMES (June 23, 2012), http://www.nytimes.com/2012/06/14/business/how-broccoli-became-a-symbol-in-the-health-care-debate.html [https://perma.cc/J9LD-PJWG]. Another example can be found in New York City's "big-soda ban." *See* Michael M. Grynbaum, *New York's Ban on Big Sodas Is Rejected by Final Court*, N.Y. TIMES (June 26, 2014), http://www.nytimes.com/2014/06/27/nyregion/city-loses-final-appeal-on-limiting-sales-of-large-sodas.html [https://perma.cc/D9TE-VD4Z].

182. The concept of autonomy in law and philosophy is deeply controversial. *See, e.g.*, SARAH CONLY, AGAINST AUTONOMY: JUSTIFYING COERCIVE PATERNALISM (2013). Professor David Strauss has noted that "autonomy is a notoriously vague notion; there is a danger that any attempt to justify a principle in terms of autonomy will slip into question-begging assertions about the nature of truly free and rational human beings." David A. Strauss, *Persuasion, Autonomy, and Freedom of Expression*, 91 COLUM. L. REV. 334, 354 (1991). Still, there is no question that individual autonomy is implicated by the power of the state to create limitless microdirectives to achieve virtually any legislative objective.

183. Additional concerns would arise if individuals do not know who owns the controlling technology. *See* Dan Gillmor, *In the Future, the Robots May Control You, and Silicon Valley*

As the Internet of Things continues to expand, this could be true of most daily actions.

From a technological perspective, the move from microdirectives to automatic restraint is small. From an ethical and policy perspective, however, it is enormous. The benefits of such a move include increased compliance and increased certainty, while the costs arrive by way of a large loss of individual autonomy. One might think such a rule were appropriate if the restraint kept a gun from firing in a situation that would be murder. But things would be different if the rule related to something less malicious like parking in an illegal spot outside a hospital in an emergency or something mundane like crossing a neighborhood street. Our prediction about the death of rules and standards does not necessarily imply prior restraint, which is a topic that needs to be addressed separately.[184]

3. Ethics

There may be additional concerns that the death of rules and standards will erode moral decision making. Some argue that individuals who solely follow rules and directives will become robotic—mere automatons who fail to appreciate the moral choices that should underlie their actions.[185] This is a point made by Professor Shiffrin.[186] Forcing individuals to engage in moral deliberation may be important to the moral health of individuals or of a democratic society. If this is true, the death of rules and standards will bring with it significant costs. We are skeptical that anyone could stop this evolution, so the appropriate response is likely to seek out alternative outlets for human moral deliberation and take that into account in the process of determining the appropriate boundaries of the law.

Finally, people are generally uncomfortable with allowing machines to make important ethical decisions. As discussed above, the debate about Google driverless cars demonstrates this.[187] In that context, many have already begun to ask whether it is acceptable for a machine to make complex ethical decisions about life or death.[188] If we bracket Professor Shiffrin's concerns about moral atrophy, the source of concern appears to arise from a sense that humans have a unique ability to make ethical

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Will Control Them, GUARDIAN (May 13, 2014, 6:45 AM), http://www.theguardian.com/commentisfree/2014/may/13/internet-of-things-software-privacy-silicon-valley [https://perma.cc/FMA3-TYL8] (noting that autonomy, security, and privacy seem to be an afterthought of the move towards the Internet of Things).

184. *See* Michael L. Rich, *Should We Make Crime Impossible?*, 36 HARV. J.L. & PUB. POL'Y 795 (2013).

185. *See, e.g.*, Evan Selinger & Brett Frischmann, *Will the Internet of Things Result in Predictable People?*, GUARDIAN (Aug. 10, 2015, 11:56 AM), http://www.theguardian.com/technology/2015/aug/10/internet-of-things-predictable-people [https://perma.cc/29C7-5CUR] (noting that people will essentially become programmable, like machines).

186. Shiffrin, *supra* note 10; *cf.* LARRY ALEXANDER & EMILY SHERWIN, THE RULE OF RULES: MORALITY, RULES, AND THE DILEMMAS OF LAW (2001) (investigating the dilemma created between individual moral judgment and rules that restate moral principles in concrete terms).

187. *See supra* Part III.B.

188. *See supra* Part III.B.

decisions.[189] It should be noted, however, that even when a machine is making an algorithmic calculation these are human decisions. Humans decide which values the machine considers. Humans tell it what its objective is.

But that does not necessarily alleviate the concern. There is perhaps an ethical value in having a human making important instant decisions rather than placing ourselves on a course of action that cannot be reviewed in the actual moment. We suspect that a large part of what is going on here is lingering skepticism about accuracy concerns, which we addressed in Part II. People often trust human hunches more than complex machine decisions even in the face of evidence that the machines are more accurate. Perhaps it is a fear of the unknown. But as we have noted above, there is little evidence that humans will be systematically better at making these decisions than machines.

Still a deeper philosophical problem remains. Something that makes us human might be lost when lawmakers use machines to make all of our collective value judgments in advance (even if those judgments are accurate).[190] This may be at the root of the fear with which people view artificial intelligence.

These are pressing ethical problems that will face lawmakers in the future. The current trend is toward microdirectives that reduce in-the-moment ethical decisions. To understand whether that is a good thing, lawmakers must engage with philosophers and ethicists on these questions as the evolution to machine-derived microdirectives progresses.

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Before concluding, it is worth noting an implicit assumption in our prediction: the implications and consequences we discuss here will not themselves prevent the death of rules and standards. One might think that if the institutional upheaval and autonomy concerns are great enough, lawmakers will reject the move to microdirectives. We do not see this happening. The growth of predictive technology is robust. The lure of accuracy ("getting things right") and the regulated actors' desire for certainty are powerful forces that will dominate political and legal debates. The more nuanced considerations we discuss in this Part will, we think, be sidelined.

In that sense, our prediction is about the law's current course. Those who believe the costs of that course are unacceptable should focus on methods of alleviating these costs or finding means to intervene and change that evolutionary path.

CONCLUSION

As machines become increasingly intelligent, and continue to outperform human judgment, the influence of artificial intelligence will spread far and wide. The technologies we have discussed are already being used by doctors to detect cancers, by consumers to optimize their search for products, and by financial advisors to provide advice.

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189. *See, e.g.*, Lin, *supra* note 165 (noting that humans are presumed to be able to make ethical judgments, whereas computers have an untested track record).

190. *See generally* MACHINE ETHICS (Michael Anderson & Susan Leigh Anderson eds., 2011).

The legal system will not be immune from this trend. We have suggested throughout this Article that this technological revolution will dramatically alter the foundational structure of law as we know it. Predictive technology will generate greater ex ante information that can be used by lawmakers to write highly specific, complex laws. And individuals will receive notice of these complex laws in a simple form thanks to technological advances in communication. This will be the death of rules and standards and the rise of microdirectives.

These developments will have profound implications for the role of judges, legislators, regulators, lawyers, and individuals in the legal system. But beyond that, we will have to change the way we think and talk about law. Take, for example, the classic debate between legal realists and legal formalists.[191] Without ex post adjudication, this debate changes radically. As standards disappear and judges have progressively less influence, legislative intent will be entrenched and concretized in the catalog of microdirectives.

Technological changes that vastly improve ex ante information will also breathe new life into old law-and-economics models that began with an assumption that lawmakers and citizens have full information. Friction in these models caused by imperfect and asymmetric information has provided a fertile source of material for critics, both inside and outside the field of law and economics. But these models will be given renewed importance. Similarly, the public choice literature will have an increased emphasis on how legislators choose objectives, rather than how they implement laws, while academic interest in subjects such as judicial behavior will dissipate.

All of this is to say that legal institutions of all types will change radically. We are witnessing an information revolution. And, like other technological revolutions, it will precede a legal revolution. The industrial revolution, for example, saw human labor replaced by machine labor and the cost of transportation fell markedly with inventions such as the steam engine. It greatly reduced transaction costs and had widespread impact on all spheres of law including contract law,[192] property law,[193]

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191. *See generally* BRIAN Z. TAMANAHA, BEYOND THE FORMALIST-REALIST DIVIDE: THE ROLE OF POLITICS IN JUDGING (2010); Steven M. Quevedo, *Formalist and Instrumentalist Legal Reasoning and Legal Theory*, 73 CAL. L. REV. 119 (1985). On American legal realism, see GRANT GILMORE, THE AGES OF AMERICAN LAW (2d ed. 2012); WILFRED E. RUMBLE, JR., AMERICAN LEGAL REALISM (1968); ROBERT SAMUEL SUMMERS, INSTRUMENTALISM AND AMERICAN LEGAL THEORY (1982); Brian Leiter, *American Legal Realism*, *in* A COMPANION TO PHILOSOPHY OF LAW AND LEGAL THEORY (Dennis Patterson ed., 2010); Karl N. Llewellyn, *Some Realism About Realism—Responding to Dean Pound*, 44 HARV. L. REV. 1222 (1931). On formalism, see generally Frederick Schauer, *Formalism*, 97 YALE L.J. 509 (1988); Ernest J. Weinrib, *Legal Formalism: On the Immanent Rationality of Law,* 97 YALE L.J. 949 (1988).

192. *See, e.g.*, P. S. ATIYAH, THE RISE AND FALL OF FREEDOM OF CONTRACT (1979); GRANT GILMORE, *Origins*, *in* THE DEATH OF CONTRACT 5 (Ronald K. L. Collins ed., 2d ed. 1995).

193. For example, to see the feedback effect between intellectual property and the industrial revolution, see Joel Mokyr, *Intellectual Property Rights, the Industrial Revolution, and the Beginnings of Modern Economic Growth*, 99 AM. ECON. REV. 349 (2009).

employment law,[194] criminal law,[195] and tort law.[196]

The information revolution has already resulted in dramatic changes in the world of commerce. For example, companies such as YouTube, Uber, and Airbnb have disrupted and uprooted heavily regulated and stable industries. The coming technological revolution will lead to similar disruption of the legal services industry, but the effect on law will be much deeper and far wider. It will affect the very structure of legal commands and the way we, as a society, choose to govern the behavior of citizens.

194. *See, e.g.*, Clark Nardinelli, *Child Labor and the Factory Acts*, 40 J. ECON. HIST. 739 (1980).

195. *See, e.g.*, Douglas W. Allen & Yoram Barzel, *The Evolution of Criminal Law and Police During the Pre-Modern Era*, 27 J.L. ECON. & ORG. 540 (2011).

196. *See, e.g.*, Joel Franklin Brenner, *Nuisance Law and the Industrial Revolution*, 3 J. LEGAL STUD. 403 (1974).